PLEISTOCENE ENVIRONMENT AND HUMAN ECOLOGY IN INDIA

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ABSTRACT OF THE
THESIS SUBMITTED FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY
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DR. MEHDI RAZA
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DEPARTMENT OF GEOGRAPHY
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ABSTRACT

Pleistocene Environment And Human Ecology in India

An understanding of man's emergence as an artificer and bearer of culture presupposes a knowledge of the environmental setting in which the phenomenon was unfolded since it played a dominent role in influencing his way of life. The greater portion of this initial phase of man's cultural evolution falls within the Pleistocene, a period from which the earth has only just emerged. India because of its geographical position was spared intensive continental glaciations except Kashmir and adjoining regions where abundant evidences of an actual existence of Pleistocene Ice Sheets Occur.

The present work has been divided into eight chapters. The first chapter reviews the Pleistocene environmental background, summarizes the environmental chronology established by geographer, geologists and prehistorians on morphological, stratigraphical and palaeontological grounds, which shows that during Pleistocene the Kashmir Valley was a glacial lake and records a four fold glaciation with three interglacial periods. Of the four glacial periods, the first two were more intensive than

the later two. The interglacial periods were gradually longer than the glacial periods. The southward movement of the environmental zones during the colder phases and their northward shift during the interglacial periods manifested itself in a succession of pluvial and interpluvial climatic phases in the remaining parts of India. In this way we find that the enormous rhythmic changes of Pleistocene in the Punjab plains become divisible into seven stages: four pluvials or wet phases (Tatrot, Boulder conglomerate, T_2 and T_4) and three interpluvial or dry phases (Pinjor, T_1 and T_3). The Plio-Pleistocene boundary has been drawn above the Dhok Pathan stage and below the Tatrot stage where a well marked unconformity has been noticed representing a period of uplift and erosion. Since the Boulder Conglomerate zone of the Upper Siwalik merges directly with the moraines of the second Kashmir glaciation, provides a direct and independent correlation between the Boulder Conglomerate zone and the cycle of glaciation, and a firm basis for the establishment of an archaeological chronology not only for the Potwar area but also for the rest of the country. The correlation of the glacial cycle with the cycle of sedimentation in the Potwar region as well as with other regional sequences have been dealt with appropriate sections of this study.

The second chapter deals with the importance of Stone Age tools. From them one can learn about the manner and habits of their maker, their livelihood and economy. The tools of Palaeolithic man have been divided according to the typologies into Pebble tools, Core tools and Flake tools of various kinds. The following techniques of manufacturing these tools - Block on Anvil, Stone hammer or Direct percussion, Resolved flaking, cylinder hammer were the basic techniques used for the detachment of flakes. However there are some techniques described on the basis of special types of flakes produced and they are the Clactonian and Levalloisean techniques. And in the later period the advanced techniques were used to give the final touches to the tools they are the Pressure flaking, Fluting, Backing or Blunting and grinding techniques etc. To sum up the various techniques described, the basic difference is observable. In the Clactonian, Levalloisean methods of producing flakes it is pointed out that (a) the cores were usually flat; (b) the platforms wide and facted; (c) flakes round, oval or triangular. But as opposed to this in blade techniques (a) the cores were generally cylindrical and fluted, (b) flakes long, narrow and slender; (c) the platforms of the flakes show minute facets. The majority of Stone Age tools found in all parts of the subcontinent are made of quartzite- one of the oldest rock, basalt chalcedony, agate, flint, jasper chert and diorite were the basic rawmaterial for him. And the various functional aspects such as for cutting, scrapping, piercing, groving and engraving with their distribution have been mentioned.

The third chapter highlights the periodization of Indian lithic cultures and their general characteristics. The Palaeolithic or Old Stone Age is usually chronologically equated with the Pleistocene. Its subdivision into Early, Middle and Late Stone Age have been used to designate three distinct traditions of tools. The handaxe- cleaver and chopper- chopping tool traditions of India representing the beginning of its stone cultures belong to the Early Stone Age which co-terminate with the Middle Pleistocene. The smaller flake tools stratigraphically succeeding the Early Stone Age industries are designated as the Middle Stone Age; which start from the end of the Early Stone Age i.e. probably from the Middle Pleistocene and Co-terminate with the Upper Pleistocene. The pigmy tools are included in the Late Stone Age.

The fourth and fifth chapters deal with the characteristics, regional and cultural complexes of Early, Middle and Late Stone Ages. The Early Stone Age of India reveals several techniques and tool complexes but their spacial and vertical distribution is as yet not fully understood. Broadly speaking three distinct lithic traditions or complexes have been recognised (1) a biface core tool tradition broadly similar to abbevillian- acheulian complex of Europe and Africa (2) a pebble tool tradition broadly similar to the Kafuan- Oldowan of Africa and (3) a flake tool tradition coupled with pebble- tools, broadly similar to the Anyathian of Burma and Choukoutienen of China. It appears that the three traditions are but integral components of one great cultural complex. On the whole it appears that a dominant core tool tradition with biface and cleaver as its main elements was spread over larger parts of peninsular India. The pebble tool tradition is an important element within the Early Stone Age culture complex. In north India and in Punjab pebble tools are free of biface and occur as an integral part of the Soan culture. In peninsular India the pebble tools are generally found associated with biface. The flake culture of India was mainly concentrated in the Punjab where it was known as the Soan, which is generally free of the biface. The Middle Stone Age culture clearly shows that this phase was very wide spread in peninsular India. The tools of this period have been found in deposits which lie between those containing handaxes and those containting microlithic industries, in the cemented gravel of the second aggradation cycle. The Middle Stone Age was a flake tool culture, a tradition which may well have developed locally outside the handaxe and chopping tool industry of the Early Stone Age. The tool making techniques show considerable development. The Late Stone Age is characterised by microlithic industries throughout India. The tools range from extremely fine assemblages of blades and geometric forms.

The sixth chapter discusses how the country was first peopled. The physical type and habitation pattern of Palaeolithic life. Evidences show that Indian Mid-Pleistocene population was a mixed one consisting of early Homo as well as a more archaic Pithecanthropi, could have come in the country from the west. The Olduvai gorge is of great significance in this regard in showing beyond doubt that abbevillian handaxe grew out of the ancient pebble culture by the second glaciation and from these its creator carried out to different parts of the world. The most promising area appears to be the Siwalik hills which have a world wide reputation of being one of the most important centre of evolution of sub-human primates. Since India was an integral part of the archaeological realm extending from Africa to southeast Asia. Indian Mid-Pleistocene population could not but have been a local variants of the physical types found in these regions. A general idea of the premordial colonization and habitation pattern have been gained by preparing the distribution map of Stone Age sites, which reveals that prehistoric sites were closely dependent (1) upon valleys of the major rivers and (2) availability of suitable sources of stone for tool making. Therefore the location of Palaeolithic stations in river valleys - Soan in the northwest, Narmada, Korttalayar, Sabarmati, Burhablang, Maleprabha, Kirshna and Godavari of peninsular India suggest that settlements were generally located in broad valleys and terraces which provide appropriate and necessary ecological setup for their mode of living as well as raw material for their tools. The absence of Palaeolithic cultural material in the entire Indo-gangetic plain is puzzling. It does seem that by choice the Stone Age man avoided the middle part of the country. It may be because of not very suitable ecological setup for human occupance.

Economically throughout the Palaeolithic period the people were almost entirely dependent upon hunting and gathering in one way or the other. Which were characterised by: (1) naturally determined mammalian subsistence and free wandering with tools fashioned but not standardised; (2) food gathering with free wandering, hunting and earliest standardised tool making tradition and (3) food gathering with elementally restricted wandering and hunting.

We may thus visualise a small Ice Age population living in tiny groups of families or small tribes following the animals they killed for food over great tracts of the country. It was impermanent, precarious and isolated. So the life span of prehistoric man was certainly much shorter than ours, a shortness which was specially marked in women. All these aspects of prehistoric men have been discussed in the seventh chapter. The last chapter contains the conclusion of the present work.

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PREFACE

Geography and Prehistory have always had close and harmonious relationship. Lord Curzon, Huntington, Fleur, Forde and Estyn Evans are all names who made significant contribution to geography as well as archaeology and anthropology. Scholars like Baos and Herbertson made an almost complete transition from one discipline to another. The links between modern geography and prehistory have recently been strengthened by the adoption by the latter of techniques of analysis developed by the former.

The geographers main asset in undertaking prehistoric investigation is his ability to make distribution maps and thus established the relationship of archaeological sites to environmental factors in space; as has been aptly put by Renfew "Geography and prehistory meet in maps. Geography provides a whole new outlook in prehistoric research most obviously exemplified by the use of distribution map". To emphasize the role of geography in prehistoric studies Clarke in his book Models in Archaeology includes "Geographical Paradigm" as one of the four new archaeological paradigms: The term paradigm, according to him, means "the study of sites as patterned systems of features and structures within systems of sites territorially distributed over landscapes in mutually adjusted ways".

Geographers also feel interested in prehistoric studies because of the apparent "synchroneity of major cultural event and major environmental events" in the past. The study, therefore, of the affects of physical environment on early man, and cultural change in terms of environmental changes become legitimate fields of geographical enquiry.

In recent years and ecological approach has also been introduced in prehistoric studies. But an important part of both the environmental and ecological approaches has been the attempt to reconstruct the nature of past environment, especially of the Pleistocene which Sauer termed the age of man.

Pleistocene research also has a predictive value in relation to changes occurring to-day. It investigates these events of the past and present. The nature of present and perhaps future climatic trend- whether they are becoming warmer or cooler or wetter or drier in different places - is a critical question that the pattern of past climatic changes may help to resolve.

The problem of the age of the Pleistocene or Quaternary formation in India is connected with that of the rich fossil fauna found in the Siwalik Series of the Himalayan foothills. It needs only a moment's reflection to realize that man's very existence depends on plants and animals. Man is an animal himself and as such he is compelled to take organic food in order to keep himself alive. Food is the basic requirement that man draws from living nature, but in addition he obtains a large number of raw material from the same source. Similarly, the animal world supplies raw material as well as food. It is therefore obvious that the remains of plants and animals associated with the sites of early man should be studied with great care so that they will supply information about the species which men exploited, and also how he did it? And the combination of species can be interpreted in terms of environment.

From the technological point of view the begining of man may be defined by the earliest evidence of applying his intelligence. Purposeful thinking is necessary when an artifact is being made. So with increasing complexity of the tool equipment of early man it becomes easier to interpret the way in which he coped with the environment. Hence the existence of repeated Pleistocene fluctuations of environment is significant from two points; firstly it provides a broad frame work of natural chronology for the main stages of prehistory and secondly it affords some insight into the kind of challenge encounted by man's forebearers.

The study of Stone Age Man in India was initiated by Bruce Foote of the Indian Geological Survey, who resolved to look out for possible traces of 'Early Human Art' in south India during his course of survey. In 1863, he discovered at Pallavaran near Madras a true palaeolith among the debris of a pit in the laterite gravel overlying the granite gneiss. Following this first discovery he devoted the rest of his life in searching for similar traces of palaeolithic man and was soon followed by the discovery in great numbers of similar artifacts in the gravel bed of the Kortalayar and the Narnavaram river near Madras. His survey comprised the whole of south India. He gradually built up a vast index collection of prehistoric antiquities from this region and published two catalogues, one on a geographical basis and the other consisting of his own notes on age and distribution of Stone Age tools. Foote made many observations of great anthropo-geographical interest, such as regarding the material used by Stone Age man for tool making, and the effects of such material had on the density and distribution of palaeolithic population.

After this work Burkit, Cammiade and Richard discovered a fresh collection from vicinity of Madras and made conclusion that a close relation existed in those days between India and Africa. And then de Terra in 1932 had discovered stray artifacts on both sides of the Himalayas. He also saw a palaeolithic collection made in 1930 by Lt. K.R.U. Todd at Pindi Ghab in the Valley of the Soan, a region from which stray palaeolithics had been reported in 1880 and which in 1928 D.N.Wadia of Geological Survey of India noticed as abounding in primitive palaeolithic artifacts. Then de Terra, de Chardin and T.T.Paterson made intensive research in which climatic and geological aspects have received full attention. Then Movius, Krishnaswami, D.Sen, F.E.Zeuner, H.D.Sankalia and others studied these prehistoric changes in different parts of India.

Though works by Indian archaeologists and prehistorians with distinct geographical bias are numerous, Indian geographers, with few exceptions,have not shown any interest in this field of research: This work was therefore undertaken to study and analyse the initial phase of the Indian prehistory from a geographical point of view. In the following pages an attempts has been made to reconstruct the probable climatic sequence of India on the basis of the evidence from different fields- geology, geography, archaeology, prehistory and anthropology and then to study the socio-economic life of the Stone Age man in terms of environmental conditions, their origion and diffusion in different parts of India has also taken into account.

In the first chapter the writer has made a broad correlation of Pleistocene deposits and reconstructed the physical environment of prehistoric people; which was fluctuating between glacial and interglacial and pluvial and interpluvial phases of climatic change. The Northern part of India provides an ideal key for the understanding of the entire problem, and hence it is discussed in great detail.

The second, third, fourth and fifth chapters attempt a detailed classification and description of the artifacts relating to the Early, Middle and Late Stone Age industries respectively, and the cultures of these stages discussed. The sixth chapter deals with the physical types of Early men, their colonization of the country and habitation pattern.

The gradual conquering of the environment by men and the slow growth of his social, economic and technical attainments through a vast span of time has been discussed in the seventh chapter.

In expressing my thanks to all those who have helped in this work, I must first record my indebtedness to my

respected and beloved teacher Dr.Mehdi Raza, Reader in the Department of Geography, Aligarh Muslim University, Aligarh, who not only introduced me to this subject but also guided, encouraged and helped me in all possible ways throughout the period of my research.

I am also thankful to Prof.Mohammad Shafi, Head, Department of Geography and Pro-Vice Chancellor, Aligarh Muslim University for providing all the facilities in the department.

I must also express my gratitude to Dr.Naseer Ahmad, Reader in the Department of Geology, Aligarh Muslim University for providing material and good suggestions. Thanks are also due to Dr.Zamiruddin Alvi, Lecturer, Department of Geography for the suggestions about the maps.

I take this opportunity to extend my heartful thanks to the University Grants Commission, New Delhi for financial assistance for my research work. My thanks are also due to Mr.Najmul Huda Farooqi for Cartographic assistance and Miss.Archna Gaur, Research Scholar in the Department of Geography for help in preparing the index.

Last, but not the least I thank to those who helped me in one way or the other, to whom I am unable to acknowledge individually.

Bina Devi Kulshrestha

(Bina Devi Kulshrestha)

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CHAPTER I

PLEISTOCENE ENVIRONMENT IN INDIA

General

The Pleistocene is an unusual period in the earth's history. It was a time of emergent continents, deep ocean basins and high mountains, a time of profound environmental changes marked by repeated waxing and warming of huge ice sheets over large parts of the earth and a time of exceptionally rapid evolution of organic life perhaps one reason of our great interest in the Pleistocene period is its close connection with the evolution of man. There is no doubt that the greater portion of man's initial phase of cultural evolution falls within the Pleistocene.

The Pleistocene period represents an unique series of events in the four billion years of earth's history. During the preceding sixty million years of the Tertiary, the climate was warm, equitable and less differentiated than what it is now. Then within a brief span of a mere million years the environmental equilibrium was rudely shaken. An abrupt change in the long standing environmental picture was brought out when the earth witnessed alternating spasm of colder and warmer climate, the former reaching their climax in the extensive continental glaciation of the upper and middle Pleistocene in the northern hemisphere.

Most early glaciologists believed in a single glaciation during the Pleistocene but round the turn of the century Penk and Bruckner, the foremost glaciologists of Europe, found evidences in the Alps of four major advances of ice sheet. The ice ages from the oldest to the youngest were named Günz, Mindel, Riss and Würm.

As a result of the work done in the Rhine estuary and East Anglia since world war II, it has been shown that in the North sea region six Pleistocene cold phases are recognizable. They have been named Pretiglian, Ebouronian, Menogian, Elsterian, Saalian and Weichselian ice ages or their analogues.[1]

In North America glaciologists Chamberlain and Salisbary recognized five advances of the ice sheet and these they have named in proper sequence: Jerseyan, Kansan, Illinoion, Iowan and Wisconsin.

Because the record of the Pleistocene on the continents is so illegible some investigators turned to sediments of deep sea basins which provide an ideal recording machinary. A Pleistocene climatic record of four major glaciations and three interglacial stages was recognized as a result of

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1. Frenzel, B., <u>Climatic Fluctuation of the Ice Age</u>, 1973, p.54.

variations in the frequency of Globorotalia menardii complex in ten cores from the Atlantic and the Carribean.[1]

But whatever the precise number of ice advances, they were necessarily separated by equally important warmer interludes, some of which were markedly warmer than the climate of the present day.

It would appear that the number of known major glaciations or cold periods were more or less the same in many parts of the world though in many parts of the world a longer number has been postulated. But there are still great difficulties concerning the synchroneity of the individual cold or warm period in different parts of the world.

In the light of the above the Pleistocene, at least in the temperate regions, can be visualised as having at least seven major subdivisions: four major glacial and three interglacial.

Outside the glaciated areas, in tropical and sub-tropical regions, Pleistocene climatic fluctuation took the form pluvial phases of markedly greater rainfall, interrupted by arid interpluvial phases. In East Africa four

1. David, B.E. and Gaesta, W., "Pleistocene Climates and Chronology in Deep Sea Sediments", Science, Vol.162, 1968, pp.1233-1.

pluvial and three interpluvial phases during the Pleistocene have been recognized. The pluvial and interpluvial cycles are generally believed to be contemporaneous with the glacial and interglacial cycles of the temperate regions[1] but it should be borne in mind that it is still unknown whether or how closely they were in fact synchronous.

India, because of its geographical position, was spared intensive continental glaciation except Kashmir and the adjoining mountains where abundant evidences of an actual existence of Pleistocene ice sheets occur.

The Alpine Glacial Cycle in Kashmir

The Pleistocene glaciers in the Kashmir Himalaya are known to have descended as low down as 5,000 ft. altitude, as evidenced by the presence of moraines and other features. The existence of a four fold[2] glacial cycle in Kashmir during the Pleistocene period is of utmost importance for the Indian prehistory because it provides an ideal frame of reference and natural chronological sequence for events in Indian prehistory.

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1. Clark, G., World Prehistory, 1962, p.13.
2. Recently doubts have been raised against the four fold division of Quaternary glaciation in the sub-Himalayan region (Porter, Stephens C., "Quaternary Glacial Record in Swat Kohistan, West Pakistan", Geological Society of America Bulletin, Vol.81, pp.1421-1446, May 1970). He has traced only three glaciations in Swat Valley: Kalam glaciation, Gabral glaciation and Laikot glaciation. It will be interesting to study Kashmir deposits using Porter's techniques. Either Porter should find evidence for four glaciations in Swat, or on Kashmir side one should get only three glaciations.

<u>Sind Valley</u>

The evidences of Pleistocene glaciation in Kashmir are best studied in the Sind and the Liddar valleys. A Quaternary glacial cycle in Kashmir was first noted by Giotto Dainelli,[1] later by Norin[2] and confirmed and corroborated by the researches of de Terra and Paterson in 1935.[3]

Dainelli, who made intensive observations in the Sind valley, recognised four main glaciations in the Himalayas as follows:

1. First Glacial: The Sind glaciers advanced as far as Ahateng hill and Mansabal lake.

2. First Interglacial: The cemented conglomerate of Malshauhibag rest on the glacially molded hill slopes and underlies the karewa clays which were laid down as the karewa lake began to form.

3. Second Glacial: The ice advanced how far is not stated by the fluvioglacial deposits below GUnd are given in evidence.

4. Second Interglacial: Dainelli makes no mention of this stage except to point out that probably the upper karewa clays

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1. Dainelli, G., Studi Sul Glaciale: sped. lal.de. Filippi. Rec., Vol.3, 1922, mentioned by Krishna Swami in "Stone Age India", <u>Ancient India</u>, No.3, 1947, p.14.
2. Norin, E., <u>Preliminary notes on the late Quaternary glaciation of North-West Himalayas</u>, 1925.
3. De Terra, H. & Paterson, T.T., <u>Studies on the Ice Age in India and associated human cultures</u>. Carnagie Inst. Washington, Publication No.493, 1939.

were laid down in lower sind.

5. Third Glacial: The ice advanced and reached Gund.

6. Third Interglacial: This is not discussed by Dainelli.

7. Fourth Glacial: The ice again advanced in the Upper Sind as far as Sonamarg.

Dainelli noted two terraces at Sonamarg which he correlates with the fourth glaciation. He also saw the possibility of ice oscillation.[1]

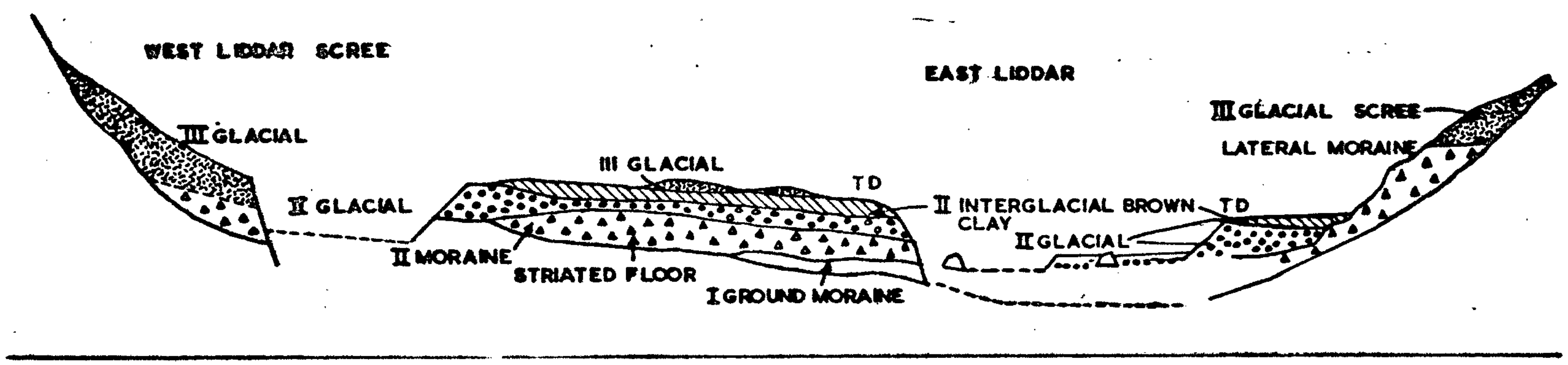
It should be mentioned here that Dainelli had equated the earliest Sind Valley glaciation with the second (Mindel) of the Alps series, making the fourth or last Kashmir glaciation a post - würm advance. De Terra and Paterson also observed the same four glaciations here but they made all the four run parellel to the Alps series.

Liddar Valley

Liddar is the second most important river of the Himalayan slopes. Above Pahalgam the river is two fold, the west Liddar, draining part of the kolahoi glacier and the East Liddar, having its source in the lake Shishram Nag which lies on the foot of Saskah (Fig.1).

1. De Terra, H. and Paterson, T.T., ibid, p.38.

CROSS SECTION OF THE LIDDAR VALLEY AT PAHALGAM SHOWING THE VARIOUS GLACIAL AND INTERGLACIAL DEPOSITS



AFTER DE TERRA & PATERSON

FIG. I

This river valley can be further divided into two parts: the upper and lower. The upper Liddar stretches from Pahalgam upward to Shishram Nag. In this section the valley is narrow, constricted and has deep gorges. The lower Liddar stretches from Pahalgam down to its confluence with the Jhelum (Fig.2).

Grinlinton[1] made a through study of the effects of glaciation in the upper Liddar valley. His observations made him divide the Liddar valley glacial sequence into two parts, a high-level,[2] epoch of early date and a late low-level epoch divisible into several stages as follows:

(a) Pahalgam Stage: When moraines were formed at Pahalgam.

(b) Second Stage: Recession of the ice to its present level.

(c) Third Stage: Advance of ice upto Nekabatun.

(d) Fourth Stage: Retreat of ice when the cup of Shishram Nag was filled.

(e) Mainpal Stage: Ice advanced beyond Shishram Nag.

(f) Last Stage: Post-Mainpal recession marked by pauses and pulsations.

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1. Grinlinton, J.L., "The former Glaciation of the East Liddar Valley", Mem.Geol.Survey of India,Vol.49, pt.2, 1928, pp.289-388.
2. In a recent study ("Quaternary glaciation and palaeolithic sites in Liddar valley", World Archaeology, Vol.X, 1975, by R.V.Joshi, S.N.Rajaguru, R.S.Pappu and B.P.Bopardikar) it has been suggested that there is only one glacial phase- the Pahalgam phase- at lower altitudes which enters directly into the stratigraphic sequence at this locality where Early Palaeolithic artifacts were found.

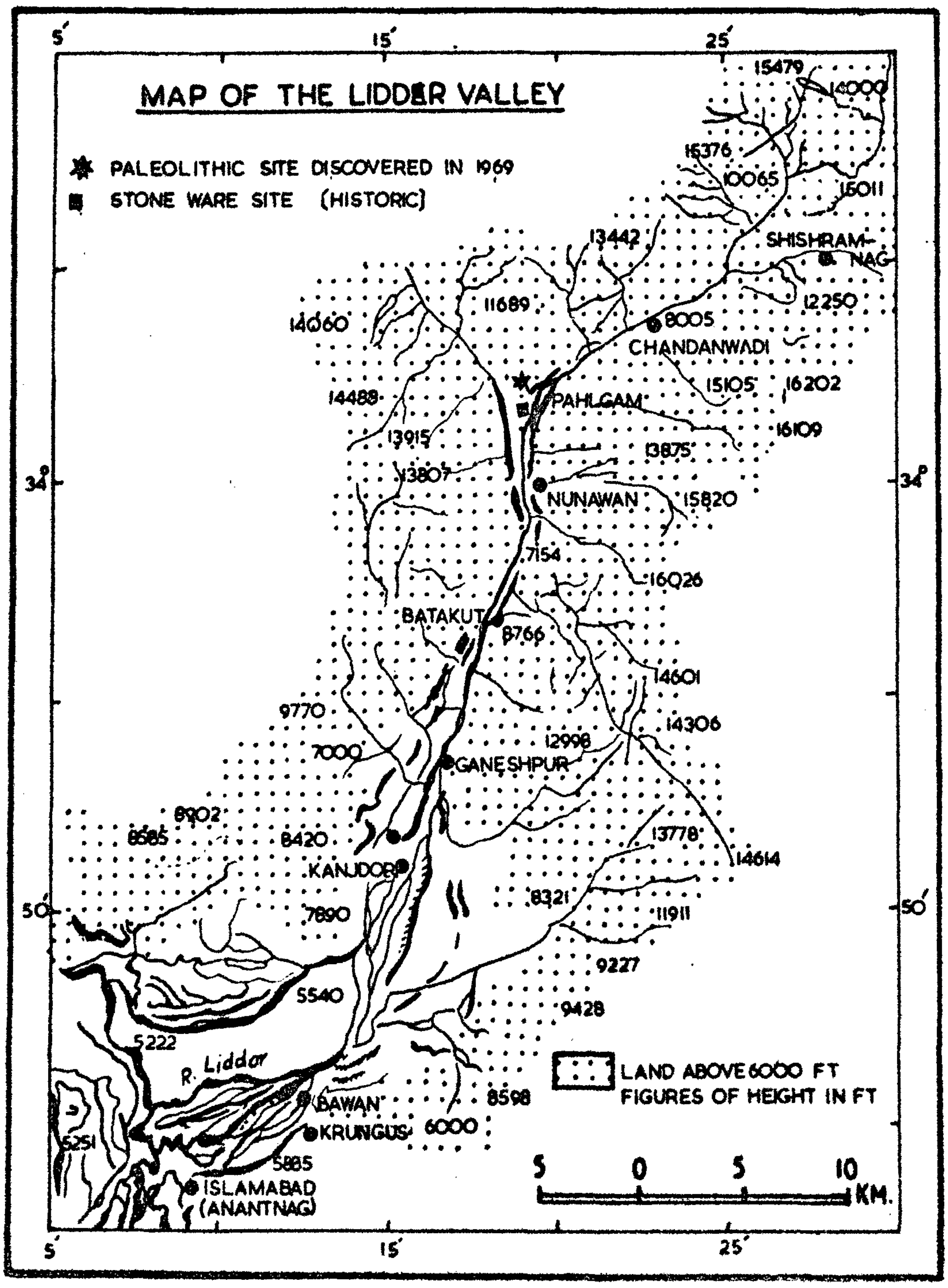

MAP OF THE LIDDER VALLEY
PALEOLITHIC SITE DISCOVERED IN 1969
STONE WARE SITE (HISTORIC)
LAND ABOVE 6000 FT
FIGURES OF HEIGHT IN FT
PAHLGAM
CHANDANWADI
SHISHRAM-NAG
NUNAWAN
BATAKUT
GANESHPUR
KANJDOR
R. Liddar
BAWAN
KRUNGUS
ISLAMABAD
(ANANTNAG)
5 0 5 10 KM.

FIG. 2

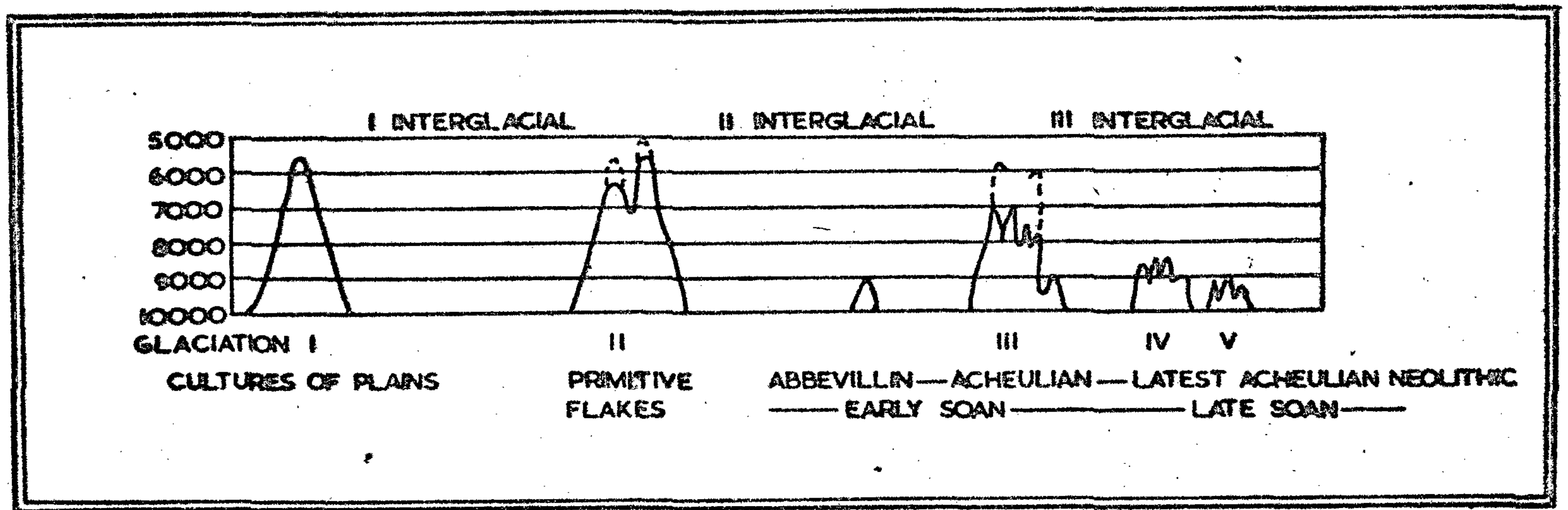
Later researches of de Terra and Paterson in the region in 1935 agree with the above scheme of glaciation in the East Liddar Valley. The observations of Dainelli, Grinlintion and de Terra and Paterson within the Sind and the Liddar Valleys clearly show that a sequence of four fold glaciation, with three interglacial periods, can be recognised in Kashmir. Of the four glacial periods, the first two were more intensive than the later two. Apart from the major interglacial period seperating the four glaciations, each glaciation itself was marked by secondary interglacial pulsations, which were more evident during the later glaciations than the early ones. At least two advances can be recognised in the second glaciation, four advances and a retreat halt in the third and four advances and several retreat stages in the fourth.[1] (Fig.3).

The interglacial periods were generally longer than the glacial period, and the relative duration of the interglacial period was in the ratio of 4:5:4 for the first, second and third respectively.[2]

Kashmir Valley

The Kashmir Valley was throughout the Quaternary

1. De Terra, H. and Paterson, T.T., op.cit., p.98.
2. ibid., p.80.



After De Terra

DIAGRAM TO ILLUSTRATE RELATIVE DURATION OF GLACIAL AND INTERGLACIAL PERIODS WITH APPROXIMATE RELATIVE INTENSITY OF GLACIATION AS INDICATED BY RESPECTIVE LIMITS OF GLACIER ADVANCE (HIMALAYAN SLOPE)

FIG. 3

a glacial lake[1] and records the fluctuations of a polyglacial cycle. The chief geological formation of the ice age here is the huge karewa series. Forming part of the upper Jhelum Valley, the alluvial basin of Kashmir has a length of about 84 miles and a breath of some 20 to 25 miles, and lies at an altitude of 5,200 - 5,500 feet. It separates the Pirpanjal on the southwest from the great Himalaya on the northeast; it has an area of at least 2,000 square miles. It is occupied partly by low-lying alluvial deposits not much raised above the level of the Jhelum river, but principally by older beds exposed in elevated plateaux or terraces on the left bank of the Jhelum along the south-western border of the younger alluvial plain, and elsewhere projecting through the latter as islands. These plateaux are known by the Kashmiri term KAREWAHS, (Karewa) a name which has been adopted for the deposits of which they are built.[2]

The origin of this Karewa lake was discussed by Godwin[3] Austin and Lydekker[4] and both are of the opinion that the formation of the lake was connected with the uplift of the

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1. Krishnaswami, V.D., "Stone Age India", Ancient India, No.3. 1947, p.15.
2. Pascoe, E.H., A Manual of Geology of India and Burma, Vol. III, p.1932.
3. Godwin Austin, H.H., "Geological notes on parts of North-Western Himalayas", Geol.Sec. Lond., Quart. Jour., Vol.20,1864, p.383.
4. Lydekker, R., "The Geology of Kashmir and Chamb Territories and the British District of Kagon", Mem. Geol. Surv. Ind., Vol.22, 1883, p.78.

Pirpanjal and that its spilling over by over-flow cut the Jhelum gorge below Baramula. The Karewa series are composed of partly fluviatile but mostly lacustrine deposits.[1] According to Krishnan, the big sinking lake lying between two slowly rising mountains on either side, in which the Karewa sediments were deposited, must have been formed by a barrier which was a spur of the mountain between Baramula and Rampur. The uplift of the Pirpanjal might have formed a great dam across the over flow channel and accentuated the formation of the lake. The ancestral Jhelum finally cut through the barrier at Baramula and drained the lake(Fig.4).

The Karewa have been divided by Lydekker into a Lower group and an Upper group.[2] The former is tilted and probably corresponds to some portion of the Upper Siwalik. The latter is younger and more or less horizontal. Probably all but the upper most 1,000 feet of a total thickness of 4,500 feet belongs to the older group. The lower division is greyish and contain bands of green sand, marl and clay, whereas the latter are brownish.

1. Krishnan, M.S., Geology of India, 1968, p.504.
2. Pascoe, E.H., "A Manual of the Geology of India and Burma, Vol.III, 1964, p.1933.

PROPORTIONS AND MAGNITUDES OF FOUR GLACIATIONS OF KASHMIR
STRIPPLED AREA IS GLACIATED AND SNOW BOUND TERRAIN

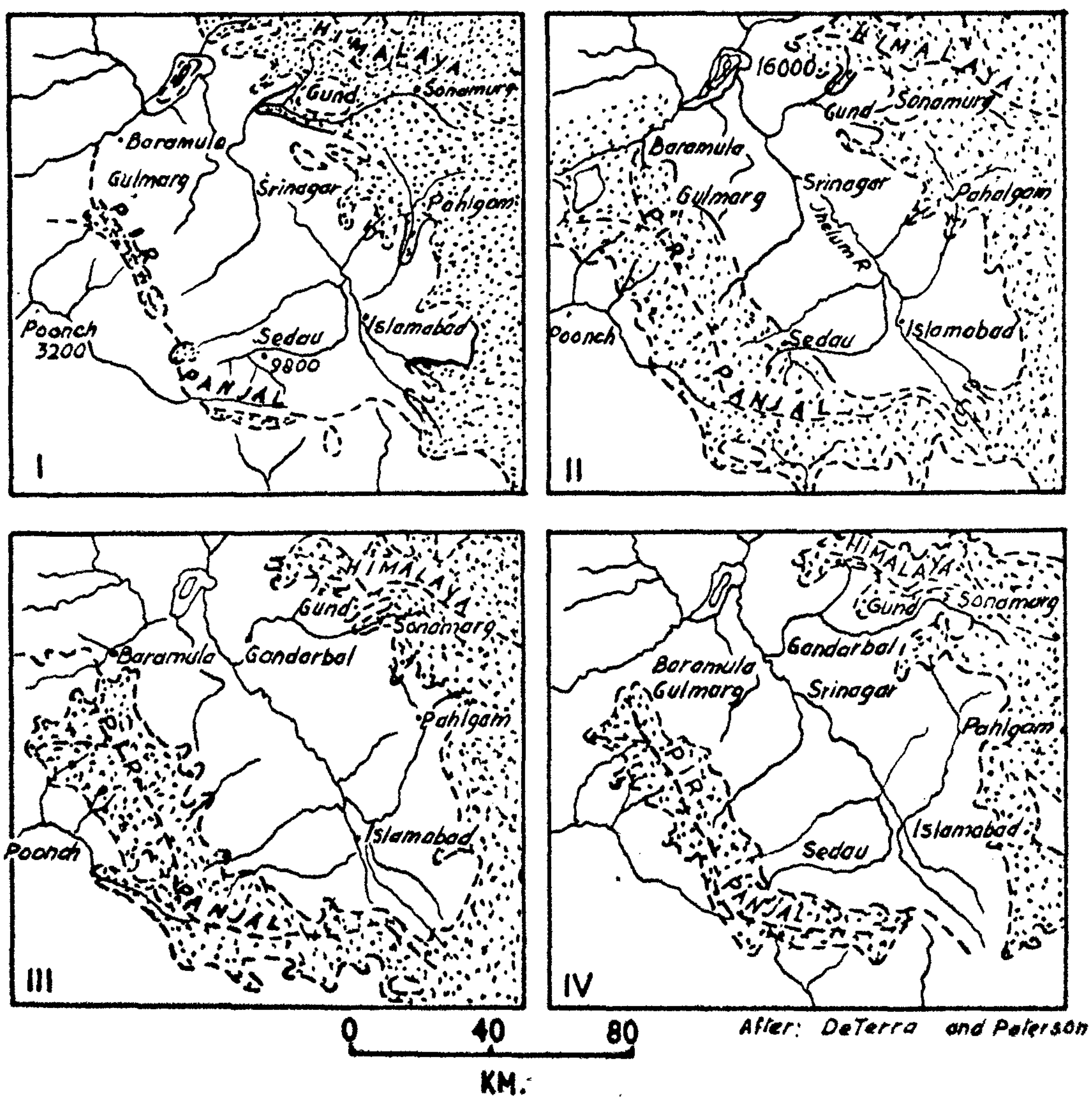

FIG. 4

TABLE I

Glacial and interglacial deposits in the Karewa series, Pirpanjal Range.[1]

UPPER		
	Morains and terraces of IV Glacial Stage, III Glacial Stage. Well-bedded sands and clays with boulder and erratics. Varve clays. Basal boulder-bed II Glacial Stage.	Plant fossils locally abundant. Many gastroped and other land molluscs.
LOWER		
	Fine buff and blue-grey shales, sands and gravel, crossbedded, varve clays. I Glacial stage. Dark carbonaceous shales and sand stones with thick conglomerate and lignite seams. Silt and clays.	Fossil leaves, fruit and spores of rose, cinnamon, oak, maple, walnut, trapa; diatoms; landshells, Elephas hysudricus, Rhinoceros sp., Cervus sp., Schizothoracine fish remains, bird and sub-tropical low land plants.
	Pre-Glacial	
	Pre-Tertiary	

The two Karewa groups are separated by anunconformity and both generally dip towards the Kashmir valley. The final

1. Wadia, D.N., Geology of India, 1966, p.384.

phase of the uplift of the Pirpanjal occurred subsequent to the deposition of the Karewa and is believed to have tilted and folded the deposits. This event took place probably after the advent of man in the region.

Along the shore of the Karewa lake a number of terraces can be recognised, the highest being at 1,800 m. Another terrace occurs at a height of about 1,630 m. During the second interglacial period, there are indications that the lake was deepened and that an uplift of the Pirpanjal took place. After this the Jhelum was in a position to gradually cut through the barrier and drain the lake.

The glacial terraces are mainly found in the transverse valleys of the flanking mountains. The first terrace was cut into the Karewa by rivers that dissected the soft silt untill they reached the underlying resistant gravel fans. The river must have been active in this way before the third glaciation because moraines are found at a much lower level, 100 feet beneath the surface of the fans of the second glaciation.[1] The terrace could have been formed only during an interglacial phase when the stream were actively down cutting and therefore glacial terrace must belong to the earlier

1. Krishnaswami, V.D., op.cit., p.15.

half of the second interglacial period.

The second terrace is not well preserved but the third which is very wide is, according to Krishnaswami, degradational in origin and must be placed in the third interglacial. The fourth glaciation was not very intensive in Kashmir and the corresponding terrace lie up to 50 feet above the present stream level. The lowest terrace, which concludes the system in the valley, is found about 20 to 30 feet below an erosional slope cut in terrace.

In general the above geomorphological record is indicative of an inland lake which underwent fluctuation of the level and gradual silting. These events were clearly determined by a climatic cycle. The glacial terraces were mainly due to alternating period of stream aggradation, corresponding to glacial stages (Terraces 2,4 and 5) and degradation, in the interglacial stages (Terrace 1 and 3).[1] The sequence begins from later half of the second interglacial.

According to de Terra and Paterson the Pleistocene of Kashmir can either be divided into glacial and interglacial stages or into Lower, Middle and Upper Pleistocene stages. The latter approach is more scientific as it fully reflects the

1. Krishnaswami, V.D., op.cit., p.16.

structural and erosional breaks in the sequence. The first or the lower Pleistocene sub-division embraces the first glacial and the first interglacial stages, separated from the middle Pleistocene complex by an angular unconformity. The faunal complex of these stages is characterized by primitive elephants and it is on this basis that it is correlated with the post Pliocene Villefranchian fauna of Europe.

The Middle-Pleistocene, separated from Upper-Pleistocene by another erosional break, consists of the second glacial stage and the following long interglacial. The Middle-Pleistocene is characterised by the formation of boulder forms and eroded subsequently. The second glaciation was very effective and sedimentation excessive. Similarly erosion during the second interglacial stage was very prolonged and the two sub-stages in the valley (the upper karewa and the upper terrace) belong to this phase. In Europe also, according to Penk and Brilckner, the second interglacial was the longest and accounted for one third of the entire duration of the Pleistocene.

De Terra and Paterson[1] point out that the two main processes involved in the Pleistocene history of Kashmir - a diastrophic and a climatic cycle- are so interlinked that only

1. De Terra and Paterson., op.cit.,p.221.

a historic account would do justice to the peculiarities of the process (Fig.5).

Lower Pleistocene

First glaciation: During this phase the Kashmir Valley was less elevated and the southern rampart of the Pirpanjal was of lesser height. Glaciers in Sind and Liddar descended down to the mouths of the valleys and the altitude of the glaciers on the valley flanks was probably small. The climate should have been temperate but somewhat colder than at present.

First interglacial stage: The retreat of the ice of the first Himalayan glaciers and the simultaneous uplift of the Pirpanjal dammed the Jhelum valley and the resultant lake had its outlet near Baramula but could not be effectively drained due to the great height of the barrier, resulting in heavy lacustrine sedimentation on the valley floor. The maximum inundation of the valley took place during this phase. The climate was milder and not very different than the present climate. Forests of pine-oak, such as are now restricted only to the southern slope of the Pirpanjal watershed, then extended further to the north. Hence the Pirpanjal could not have been as effective a barrier as they are now and the

CURVES SHOWING APPROXIMATE RELATIONSHIPS OF QUATERNARY GLACIAL AND PLUVIAL STAGES IN INDIA BETWEEN 30° AND 20° N

THE ARROWS INDICATE THE MAIN PERIODS OF DIASTROPHISM EROSION

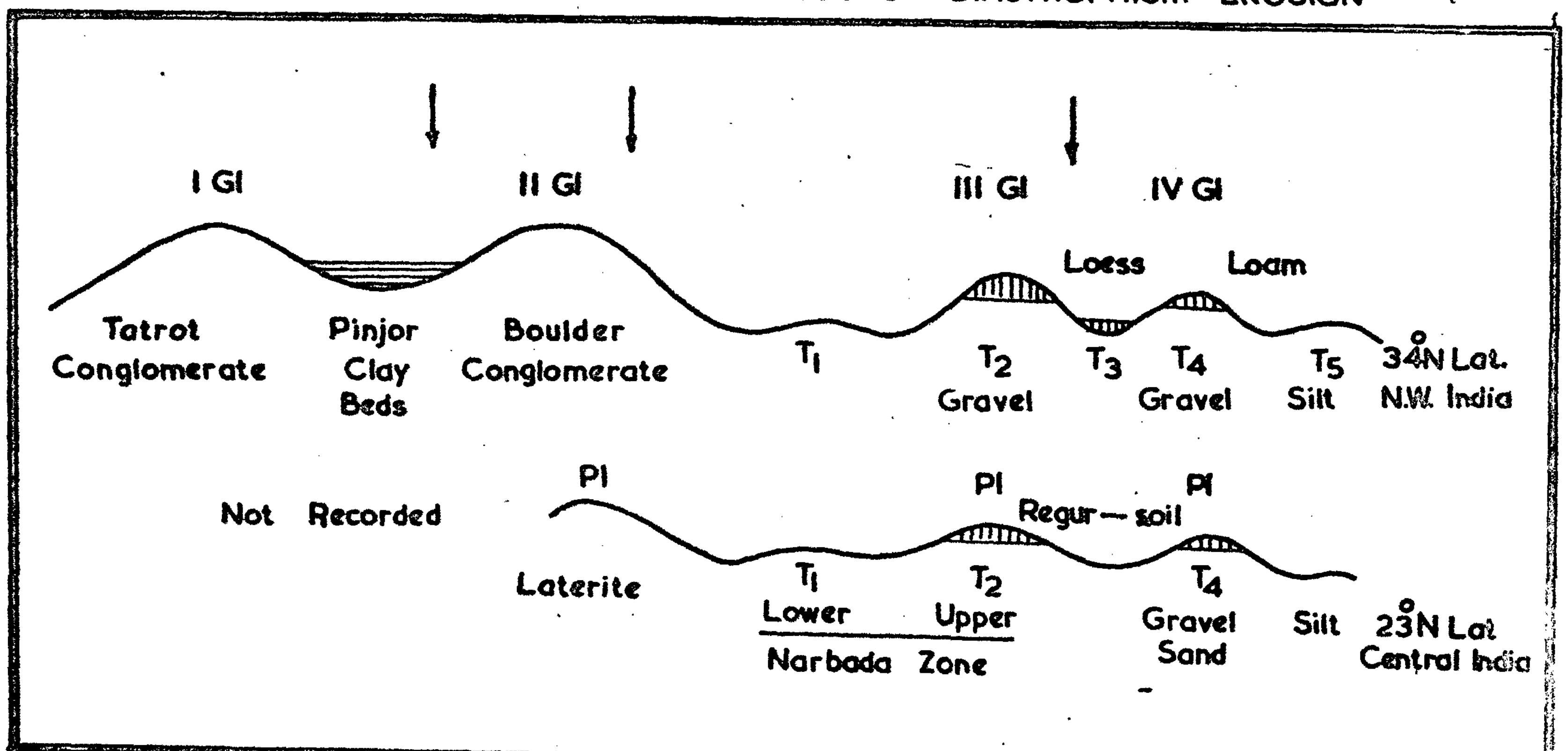

Fig. 5 (AFTER-DE TERRA)

lower tracts to the north should have been more warmer and humid in summer.

Middle Pleistocene

Second glaciation: Diastrophic forces were very strong and both the Himalayas and the Pirpanjal were sharply raised. The former uplifted fairly high to be effectively glaciated. Lack of mammalian fauna suggests a distinctly colder climate.

Second interglacial stage: The Karewa lake had gradually drained and the valley was subjected to eolian drift and seasonal duststorms. The Upper Karewa beds were deposited during this stage and the first terrace was cut. It was a period of prolonged deglaciation and erosion.

Upper Pleistocene

Third glaciation: Glaciation was less intense, nevertheless glacier tounges reached low latitudes along steep valley slopes. During this stage the upper Indus region was extensively inundated resulting the deposition of lacustrine sediments of glacial eolian origin.

Third interglacial stage: The melting of the glacial ice resulted in the reativising of stream energy which lay dormant during the glacial stage. Vertical erosion was intense. Presumbly mountain uplift continued but on the whole it was a period of comparative tectonic calm as is suggested by the great width of terrace three.

Fourth glaciation: Glaciation during this stage was not very extensive, the glaciers occupying not more than one-fourth of the region previously glaciated. The glaciers did not melt uniformly but with many pulsation and retreat stages, at least four of which can be distinguished in the sind valley.

Faunal and Floral Evidence of Pleistocene Climatic Fluctuation in Kashmir

The Karewa formations are of a great importance because of their fossiliferous nature. A detailed list of the flora and fauna contained in the Karewa beds is given by de Terra and Paterson.[1] An important characteristic of the Karewa flora is the common occurrence of oak. This tree at present does not occur on the northern slopes of the Pirpanjal but is a characteristic feature of the southern monsoon slopes. As the oak implies a monsoon climate, the climate of the valley during the first interglacial period must have been more humid

1. De Terra and Paterson, T.T., op.cit., pp.118-125.

and slightly warmer than at present. It therefore, appears that during the period when the Karewas were being deposited the Pirpanjal barrier was of lesser height than now,[1] the late uplifting of the Pirpanjal caused a southward migration of the monsoon forest.

The Karewa beds also contain fossils of fish, numerous unidentifiable animal bones and tusk and skeletal remains of primitive elephants. The Lower Karewa contain at one place (sombur limestone quarry about 20 km. southeast of Srinagar) vertebrate remains with primitive elephants- Elephas hysudricus which indicates an early (Lower) Pleistocene age and a late Siwalik fauna. It is on the basis of the occurrence of this primitive elephant that de Terra and Paterson assign the Karewa formation to an early Pleistocene age.

The Pleistocene Climatic Sequence in the Peri-glacial Punjab Plains

In the peri-glacial Punjab plains the Pleistocene climatic fluctuations did not manifest themselves in a series of alternating glacial and interglacial phases because of the latitudinal position of the region but there are numerous evidences to suggest that there was a corresponding cycle of

1. Pascoe, E.H., op.cit., p.1934.

alternate pluvial and interpluvial phases resulting in aggradation and degradation and formation of terraces. This is best evidenced in the Soan valley of Potwar plateau near Rawalpindi. The Potwar plateau, covering an area of about 7,000 sq. miles, is bounded on east by Jhelum, on the west by the Indus, on north by the Pirpanjal and on the south by the Salt range. This elevated plateau occupies an important position in the pre-historic settlement of the country as it appears to be the northern limit of effective settlement during the early part of the stone age. The activities of the ice age man in the region is intimately bound up with the physiographic and climatic cycle of the Quaternary era.

The Plio-Pleistocene Boundary in the Potwar

The determination of the Plio-Pleistocene boundary is of great importance in determining the age and environmental background of pre-historic man. It must be admitted in the outset that few stratigraphic problems of the Pleistocene are as difficult as the satisfactory delimitation of the boundary between the Pliocene and the Pleistocene. E.Haug[1] in 1911, evidently fulfilled a long felt necessity for a clearcut demarcation between the Pliocene and Pleistocene mammalian fauna.

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1. Haug, E., Traite de Geologic, Vol. II, No.3, 1911.

According to Haug the sudden appearance of the genera Elephas, Equus and Bos in the Villefranchian marks the beginning of the Pleistocene. Although Haug's original statement was made with particular reference to Europe; it nevertheless holds for Asia and Africa as well. In addition to Equus (the non-dactyle horse), Elephas (Archidiskodon of the planiform group) and Bos (true cattle) the first camel (camelus) appears at this time in Northwest India and China. Thus from the palaeontological point of view, the boundary between the Pleistocene and Pliocene may be fixed on a firm basis by the comparatively sudden appearance of the villefranchian fauna.[1]

In recent year, Hopwood, Matthew, Colbert, Lewis and de Terra have been its principal supporters and it received further impetus in 1948 when the International Geological Congress adopted this definition of Pleistocene for world wide correlation. The criterion however is not without serious limitation. The Villefranchian spans a long period of strongly fluctuating climate which is ultimately responsible for the glacial spasms which marks the climax rather than the beginning of the Pleistocene Ice Age. It is also not fully known whether or not the Villefranchian fauna ever-where was

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1. Movius, Hallam L.Jr., "Early Man and Pleistocene Stratigraphy in Southern and Eastern Asia", Papers of the Peabody Museum of American Archaeology and Ethnology, Harvard University, Vol. XIX, No.3, 1944, p.8.

accompanied by glaciation. Also in Asia uplift and diastrophism on a large scale occurred at the beginning of the Pleistocene. It has been shown by de Terra that an angular unconformity is encountered at the base of the Pleistocene from Caucasus to Central and Eastern Asia, forming a structural break in the late Cenozoic sequence.[1] Taking into account these limitations an acceptable boundary has since been proposed on a three fold basis,[2]

(a) tectonics and stratigraphy, (b) the appearance of new forms of animal life, and (c) first evidence of major climatic deterioration.

In the Potwar region, the delimitation of the Plio-Pleistocene boundary is bound up with the Siwalik stratigraphy and its rich faunal content. The Siwalik formation in this region consist of a fresh water deposits 20,000 feet thick and ranging in age from late Miocene to early Mid-Pleistocene. The Potwar Siwaliks have been sub-divided as follows, the names of the various sub-divisions came from localities in the region.[3]

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1. De Terra, H., "Geological Dating of Human Evolution in Asia", The Scientific Monthly, Vol.LI, p.121.
2. Butzer, K.W., Environment and Archaeology, 1964, p.20.
3. Krishnan, M.S., Geology of India, 1960, p.545.

TABLE II

Sub-Division of the Potwar Siwaliks

Upper Siwalik (6,000-8,000 ft.)	Boulder conglomerate stage (2nd glacial)	Mid-Pleisto.
	Pinjor Stage (1st interglacial)	Lower Pleisto.
	Tatrot Stage (1st glacial)	Ville frenchian
————	Unconformity ————	Upper Pliocene
Middle Siwalik (6,000-8,000 ft.)	Dhok Pathan Stage	Mid-Pliocene
	Nagri Stage	Pontian fauna
Lower Siwalik (5,000 ft.)	Chinji Stage (Pontian)	Lower Pliocene
	Kamlial Stage	Upper Miocene

The Lower and Middle Siwaliks are stratigraphically and faunistically similar but a distinct sedimentary and faunal break separates the Middle from the Upper Siwalik. The typical pontian fauna of Middle Siwalik consisting of the horse (Hipparian) and other grazing animals typical of open dry plains disappeared and is suddenly and simultaneously replaced by the typical villefrachian fauna consisting of Equs, Elephas and Boş. The absence of fossil anthropoid from the Tatrot bed does indicate a sudden deterioration of climate and the retreat of tropical belt from the Himalayas.

The major faunal and stratigraphic break between the Dhok Pathan Zone of Middle Siwalik and the Tatrot zone of the Upper Siwalik has been adopted by de Terra and Paterson as the Plio-Pleistocene boundary in this region.[1]

Tatrot Stage

On palaeontological and geological grounds the Tatrot zone of the Upper Siwalik has been correlated with the first Kashmir glaciation.[2] (On this basis the first Himalayan ice advance is referable to the beginning of the Pleistocene with the advent of the new immigrant villefranchian fauna). The Tatrot sediments which consist of conglomerates, sandstones and silts show evidence of quick deposition in the pre-existing lowlands of the Potwar plains. Red beds are conspicuously absent. Delta structure and quick changes in facies are very common. The thickness of the Tatrot sandrock is about 1,000 feet and rapid accumulation of this extent could have been made possible only with the help of powerful stream and abundant rainfall. The rejuvenation of the stream was accelerated by the uplift of the Pirpanjals which occured during the first glacial stage. This resulted in rapid denudation. The "sedimentary precipate" of the Tatrot stage was aided by the

1. De Terra and Paterson, op.cit., p.255.
2. Krishna Swami, V.D., Stone Age India, Ancient India, Bulletin of the Archaeological Survey of India, No.3, Jan. 1947. p.20.

uplift mentioned above and a more moist climate. A moist climate and abundant vegetation is further attested by the prevalance of such fossil remains as elephants, pigs, hippoptamus, bovids and crocodiles.

Pinjor Stage

There is little difference between the fauna of the Tatrot bed and the overlying Pinjor beds but lithologically the two are different. The Tatrot bed is composed of grey gravel where as the Pinjor is dominated by pink silt and sand. The pink colour is indicative of some-what drier conditions. The thickness varies from 150 to 450 m. The lithological difference between the two beds indicate a climatic change, similar to an interglacial changes in Kashmir when the pre-karewa fans of the first glaciation are overlain by Lower karewa lake beds. The eolian drift accumulated in the foothill region has a loassic content, indicative of monsoon conditions such as would obtain during an interglacial stage. The absence of anthropoid apes suggests a sub-tropical climate for this stage similar to northern central India at present.

Boulder Conglomerate Stage

A revival of diastrophic activity towards the close of the Pinjor stage brought to a close the sedimentation cycle going on the region since the close of the Middle Siwalik stage and an angular unconformity seperates the Pinjor bed from the overlying Boulder conglomerate bed. In the mountains this uplift was accompained by glaciation. In the foothills of the Pirpanjal and the Potwar ridges, denudation was most severe and resulted in the deposition of thick fans of Boulder conglomerate. This uppermost stage of the Siwaliks, (Boulder conglomerate) is widely developed along the more central part of the Potwar plateau, a large area of which is covered by the disintegrated boulders. The pebbles in these beds, ranging upto 18 inches in diameter, are made up very largely of metamorphic and igneous rocks of an exteremely varied assemblage, a small percentage being of limestone including the nummulitic variety. The beds of conglomerate are inconstant and have intercalations of soft grey sand-rock and orange clay. In view of the coarse and thick nature of the Boulder conglomerate beds, it can be assumed that the stage was characterised by intense erosion in the elevated tracts and abundant water supply such as would obtain during pluvial phase. The fauna of this stage is very scanty,[1] (consisting of Bubalus platyceros, Bubalus bubalis, Bubalus palaeindicus,

1. Pilgrim, G.E., De Terra and Paterson, "Preliminary notes on a revised classification of the Tertiary Fresh Water deposits in India", Rec. Geol. Surv. India, Vol.90, 1910, pt.3, p.192.

Bosnamadicus, *Equus namadicus*, *Beselephas namadicus*, *Hippopotamus*, *Camelus*, *Crocodiles* and *Chelonians*). This faunal scarcity suggests a glacial climate. The Boulder conglomerate beds also directly merge with the morains of the second glaciation which being very extensive, reached down to the boundary of the plains. This correlation is important because it provides an independent linking of the Upper Swalik zone with the glacial sequence in Kashmir.

The landscape of the Potwar plateau of this time "must have presented a pleasing sight, with wide flood plains sufficiently covered by vegetation to allow abundant grazing for elephant, horses and buffaloes". The Boulder conglomerate contain also relics of pre-historic man whose appearance coincides with the rapid disappearance of mammals.[1]

Post-Siwalik Stage

The post Siwalik stage in the Potwar region was marked by alternate intense erosion and deposition during which the present drainage pattern of the area was initiated. Erosion was accelerated by a crustal movement which tilted the Potwar beds. Prolonged erosion during this period gave rise to a terrace, which is a degradational terrace 220 feet

1. Krishnan, M.S., *Geology of India and Burma*, 1968, p.488.

above the stream level in the Soan Valley and 410 feet in the Indus. The first terrace is correlatable with the second interglacial,[1] the climate of this phase must have been drier than previously obtaining in the area.

De Terra and Paterson point out that this is easy to satisfactorily ~~to~~ explain the origin and by implication the climatic conditions responsible for it, by referring to the present conditions prevailing in the region.[2] The region at present experiences great dust storms before the monsoon rains break in April or May. The dust which is heavily suspended in the air in the pre-monsoon period, settles down on the surface as a thin film of silt. This process must have been in operation more intensively during a period when the Kashmir Himalayas were heavily glaciated because of turbulent winds at the edge of the glaciated highlands. Pre-historic man must have experienced these mighty dust storms because his presence in the region during this period is a archaeologically attested.

The fauna contained in the Potwar loess layers shows a scarcity and impoverisation in comparison with the

1. Krishna Swami, V.D. op.cit., p.21.
2. De Terra and Paterson, op.cit., pp.269-271.

Siwalik beds. This can be explained by the impact of cold temperate conditions on the fauna. It however, conveys a picture of a semi-arid land, inhabited by horses, bison, camel and wolf.

The process of settling of eolian drift in the Potwar region went on intermitently throughout the Pleistocene period and the "potwar loess" phase was followed by another during which river and wind drift accumulated rapidly in the depressions. De Terra and Teilhard termed this "redeposited potwar" and later was termed "loessic loam" by de Terra and Paterson. This was a period of prolonged erosion which is recorded in a terrace (T_3), a degradational terrace 80 feet above the stream level in the Soan valley. This terrace is interposed between terrace two and four and its position in the entire sequence makes it undoubtedly of third interglacial age.

Separated by a well developed slope of 30 to 90 feet, which must have resulted through an uplift during the Upper Pleistocene time, from the third terrace is the fourth and last terrace. This closes the Quaternary cycle in this region. This is an aggradational terrace composed of pinkish loam sand and gravel. These deposits, in contrast to the Potwar loess, are not so much wind-borne as a river deposit.

This may imply that the dust storms were not as powerful and intense as previously though eolian supply was not entirely cut off as is indicated by the fineness of the grain in the younger terrace silt. Cultural layers embedded in these layers indicate that deposition should have occurred in the late Pleistocene period when comparatively advance communities were present in the area (Fig.6).

The above discussion clearly indicates that the Quaternary period witnessed four periods of heavy sedimentation in the plain, one each in early and middle Pleistocene stages and two in upper Pleistocene. The fourfold cyclic sedimentation was due to the interplay of two cyclic processes, diastrophic and climatic though the intervention of other factors cannot be totally ruled out.

Correlation of the Quaternary Sequence in the Potwar Area with the Ice Age Cycle in Kashmir

A four-fold glacial sequence has been established for Kashmir by de Terra and Paterson. Correspondingly, in the adjacent periglacial region of the Punjab there was cycles of alternate pluvial[1] and inter-pluvial phases

1. The term "pluvial" implies a time span of the Pleistocene during which rainfall was locally much in excess of recent times.

COMPOSITE TRANSVERSE SECTION THROUGH THE SOHAN VALLEY SHOWING THE STONE AGE SEQUENCE IN RELATION TO ITS PLEISTOCENE TERRACES AND THE UNDERLYING LATE CAINOZOIC SIWALIK STRATA

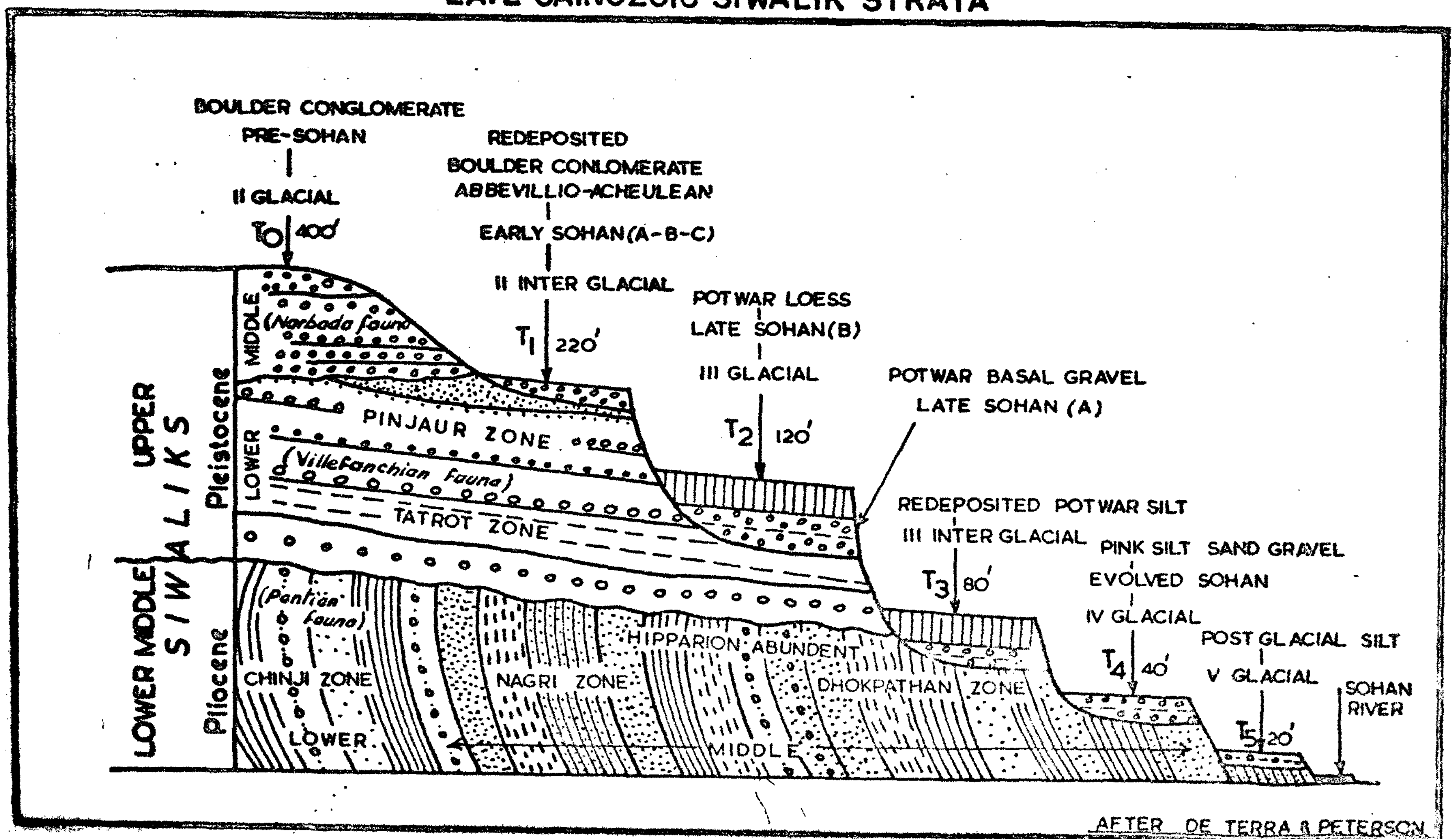

FIG. 6

resulting in aggradation degradation and formation of terraces in the river valleys. There were in the main four wet or pluvial periods,[1] each corresponding to a Himalayan glaciation. The Tatrot and Boulder conglomerate zones, and the redeposited Potwar loess clearly belong to wet phases. The Boulder conglomerate stage was homotaxial with the second Himalayan glaciation and it was during this stage that man first makes his appearance in this region. It was a period of intense pluviation in the Periglacial zone. The second interglacial phase which was very long and accounted for about one third of the whole Pleistocene, was a warm and dry phase in the Punjab Plains. The third glacial period was again a cold and humid phase with plenty of vegetation and animals. The third interglacial was a period of warm-dry climate during which potwar loess was redeposited. During the last glacial phase it was again cold and humid.

There seems to be concomitance of pluvial and inter-pluvial periods of the peri-glacial Potwar region with those respectively of glacial and interglacial in Kashmir.

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1. In a later study (De Terra, H., 'The Quaternary Terrace System of Southern Asia and the Age of Man', The Geographical Review (Amr. Geogr. Soc.), No.1, Jan. 1939. pp.101-118) dealing with a Pleistocene of Burma and Java, De Terra came to the conclusion that there are four pluvials uniformly recorded in Burma, the geologic precipate of which are in every respect similar to those described from north-west India.

The relationship between Kashmir glaciation and cycle of sedimentation in the Potwar region has been summarized by Movius as follows.[1]

TABLE III

Relation between glacial and interglacial with the Pluvial and interpluvial stages of Pleistocene.

a)	Cold Conditions	Glaciation	Deposition on the Plain
	Morain I		Tatrot Gravel
	Karewa fans		Boulder Conglomerate
	Morain T_2		Potwar Gravel and Silt of T_2
	Morain T_4		Silt of T_4
b)	Warm temperate conditions	Deglaciation	Erosion on the Plains
	Upper Karewa	T_1 erosional	
	III interglacial	T_3 erosional	

Thus the enormous rhythmic climatic changes of the Pleistocene becomes climatically divisible into seven stages as follows:

Upper Pleistocene	T_4 loam and silt	- IV glacial	=	Wurm
	T_3 Erosion period	- III interglacial		
	T_2 Potwar loess	- III glacial	=	Riss

1. Movius, H.L., Jr. op.cit, p.23.

Middle Pleistocene	T_1 Erosional	-	II interglacial	
	Boulder Conglomerate	-	II glacial	= Mindel
Lower Pleistocene	Pinjor	-	I interglacial	
	Tatrot	-	I glacial	= Gunz

It is clear that climate played a dominant role in the Late Cenozoic geological and palaeontological sequence of north-western India. There also appears to be some concomitance between climatic changes and diastrophic events leading to mountain formation in the Himalayan zone.

Pleistocene Climatic Sequence in Central India

Narmada Valley

The Narmada river of central India occupies a special place among Indian rivers- flowing as it does clear across the massif westward to the Arabian sea. Between Jabalpur and Hoshangabad the Narmada flows through a rock basin, more than 500 feet deep, filled with Pleistocene beds. The Hoshangabad - Narshinghpur region in central India appears to be an important centre of activity of prehistoric man during the Pleistocene period. Important studies concerning the region's Pleistocene deposits and its lithic industries have been made by Theobald,[1] Medlicott,[2] de Terra[3] and Khatri.[4]

The most important work is that by de Terra who visited the region in 1935 after his work in Kashmir was over. He made observations in the Narmada Valley in its stratigraphic sequence to correlate it with stone age industries. He also correlated Narmada sequence with that of the Siwalik.

De Terra disclosed the existence of four terraces in the tributary valley of Narmada at the foot of the Mahadeo hills southwest of Narsingpur. This river flows across an ancient fan before it joins the stream and in doing so has preserved remnants of four terraces on its right bank near Harpur. The highest terrace is cut into the fan and is covered by a few feet of black regur, or cotton soil. This soil extends as a uniform sheet down to the next terrace (T_2), which is underlain by red concretionary clay and sandy gravel. The gravel rests unconformably on an older series consisting

1. Theobald, W., "On the Tertiary and Alluvial deposits of the central portion of the Narbudda Valley", Mem. G.S.I., Vol.II, 1860, pp.279-291.
2. Medlicott, H.B.,"Note on celt found by Mr.Hacket in the ossiferous deposits of the Narmada Valley". Record G.S.I., Vol.II, part 3, 1873, pp.49-57.
3. De Terra and Paterson., "Pleistocene Chronology in the Narmada Valley of central India" in op.cit, pp.313-326.
4. Khatri, A.P., "Stone Age and Pleistocene Chronology of Narmada Valley (central India)", Anthropos, Vol.56, 1961, pp.519-529.

of a red, vermiculated clay underlain by sand and basal gravel. This lower group is exposed all along the slope of the fourth terrace, and at places one can see the basal gravel resting on the upturned edges of hard bed rock. Terraces 2, 3, and 4 are found at altitudes of 155, 110, and 60 feet, respectively, above stream level. Below is a wide, ancient valley flat, underlain by much finer, unconsolidated material. In this as well as in the older drift were found flint implements represting at least three different stone age cultures.[1]

In the Narmada Valley proper it is virtually impossible to distinguish terraces, but along the river the same three divisions of alluvium are exposed as are found associated with the terraces near Harpur, they are: (1) The Lower Group, (2) The Upper Group and (3) The Cotton Soil or regur Group. Each of the Lower and Upper (Narmada) Groups begins with a basal gravel overlain by pinkish or orange- coloured concretionary clays and silts (Fig. 7) There appears to be no perceptible change in the fauna of both the Lower and Upper groups but both are definitely Mid-Pleistocene assemblages of Eurasian forms.

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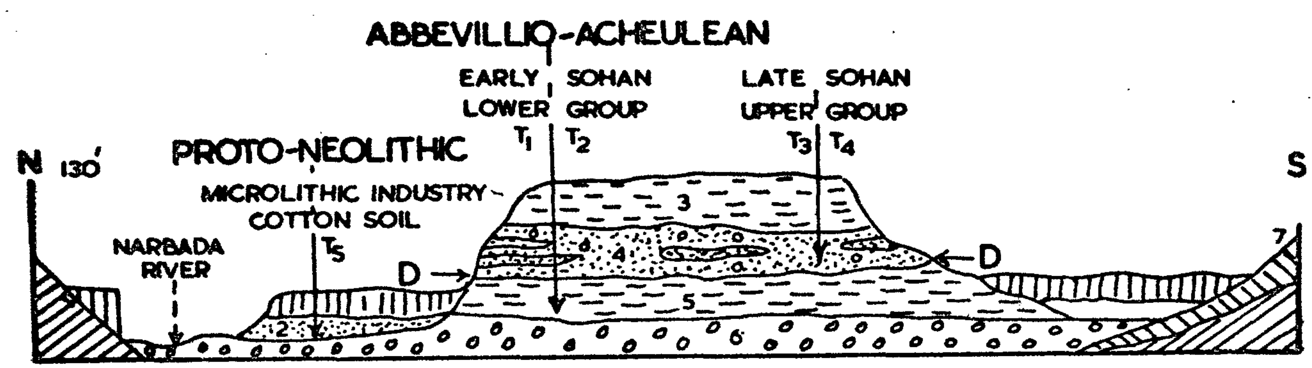
1. De Terra, H., "The Quaternary Terrace System of Southern Asia and the Age of Man", The Geographical Review, Vol. XXIX, 1939, pp.107-108.

TRANSVERSE SECTION THROUGH THE NARBADA VALLEY NEAR NARSINGHPUR

1,2, COTTON SOIL GROUP with Cotton Soil (1) and a Basal Gravel of Cotton Soil (2); 3,4, UPPER GROUP with Pink Clay (3) and Upper Gravel and Sand (4); 5,6, LOWER GROUP with Pink Concretionary Clay (5) and Lower Basal Conglomerate (6) 7, Laterite D-D disconformity between UPPER and LOWER GROUPS

Cultures correlated with the Potwar (SOHAN) terraces.



AFTER:- DE TERRA AND TEILHARD

FIG.7

The Lower Group

In this group (age: T_1 and T_2) the basal conglomerate[1] is coarser and more cemented, the clay is more intensely coloured and also richer in concretions than the upper zone. The conglomerate is devoid of any traces of lateritization. The pinkish concretionary clay overlying the basal conglomerate is, according to both de Terra and Khatri, the product of the late stage of fluvial aggradation and was deposited when the river current was very weak. Fossil mammals begin at the base of the lower group and so does the archaeological record of Ancient Man. At Umaria and Hoshangabad from the base layer 4 near the disconformity which separates both zones remains of Bos namadicus, Elephas-namadicus, Hexapratodon and Bubolus were extracted.[2]

If the two groups exhibit no faunal change, the archaeological contents, however, of the two horizons are very noteworthy. From highly cemented basal gravels of the

1. The lower Narmada group of de Terra starts with a coarse cemented conglomerate. Khatri (op.cit. p.525) however points out that the red greasy clay is the most basal bed and the conglomerate is lying against it. It's occurence is rare and observed only at four places.
2. Krishnaswami, V.D., Stone Age India, Bulletin of the Archaeological Survey of India, No.3. January 1947, p.28.

Lower Group de Terra chiselled out large flakes with prominent bulbs reminiscent of the Pre-Soan industry of the Boulder conglomerate zone of the Potwar, in addition to Abbevillian and Acheulean handaxes and cleavers and cores and flakes of Early Soan types, most of which were heavily rolled.

On the other hand, from the red concretionary clay and silt overlying the basal conglomerate a fresh upper Acheulean biface and several unrolled flakes were collected by de Terra. As the Lower Group had yielded both unworm and rolled Acheulean tools with heavily rolled Abbvillian handaxes and flakes of Early Soan, it would make the Acheulean industry contemporaneous with the deposition of the basal conglomerate. This horizon thus marks the upper limit of the Acheul industry. A similar archaeological record with the true Acheul and early Soan horizon is roughly synchronous in the Punjab with terrace 1 and 2, and therefore the same age becomes assignable to the lower Narmada. Terrace 1 correspondin to the basal conglomerate and Terrace 2 to the (younger) pink concretionary clay.

The Upper Group

(age: T_3 and T_4) The basal gravels of the Upper Group are less coarse and less cemented than those of the lower. Above this lies again a thick clay bed, less red and poorer in concretions than the older clay. From the vicinity of Narsinghpur in both horizons of this group was collected a typical Mid-Pleistocene fauna. As in the Lower Group so in the upper, there are two distinct industries both apparently derived from the lower. But one of these, the biface industry is Acheulian and rolled, pointing to redeposition from earlier gravels of the Lower Group. The other industry, which is fresh and unrolled and therefore contemporary with the Upper Group, consists of a characteristic assemblage of fresh flakes, discoidal and pebble cores of quartzite and trap. The Upper Group which is late Soan and free from biface culture may therefore be regarded as synchronous with the culture of terrace 3 and 4 in the Potwar. The age of terraces 3 and 4 becomes therefore the age also of the Upper Group, terrace 3 corresponding to the gravel and terrace 4 to the succeeding pink clay.

Cotton-Soil

Above the Upper Group there is a sharp break in the sequence of the Pleistocene beds, and a new cycle of deposition of soft sands and gravels gives rise to the lowest terrace (T_5) in the Narmada. This is the new alluvium with which is equated the brown silty clay (loessic product) known as regur or cotton soil, and it would correspond to terrace 5 of the Punjab.

All this suggests that during similar Quaternary stages the valley acted as a collecting basin for the same types of sediments as are found in the terraces of the tributary. In both cases there is a cycle from coarse gravel through sand to clay. This may imply probably a period of decreasing river activity and then the climate becoming cold and humid. And this reflects the normal evolution of stream increasing its gradient. Hence it is very probable that in central India alternating pluvial and interpluvial stages were recorded similar to those of the periglacial northern lands.[1]

Khatri[2] somewhat differs from de Terra and gives the following Pleistocene sequence in Narmada Valley:

1. Red clay (4' - 12') Early chellean tools

   Unconformity

2. Gravel (5' - 8') Richly fossiliferous but less mineralized. Pluvial conditions.

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1. De Terra, H., "The Quaternary Terrace system of Southern Asia and the Age of Man", The Geographical Review, Vol.XXIX, 1939, p.109.
2. Khatri, A.P., op.cit., p.528.

3. Sandy horizon deposited in crosscurrent lying conformably ever gravel II (25' - 30') — Fossiliferous, Pluvial conditions lessening Age: Late Upper Pleistocene

4. Yellow Silt and Black Cotton soil (3' - 15')

Khatri's scheme of geological formations along with climatic successions can be summarized as follows:

TABLE IV

Period	Geological formation	Climate
Holocene	Black cotton Soil	Interpluvial
	Yellowish brown silt with concretion	present day conditions
Upper Pleistocene	Deposition of cross bedded sand	Current sluggish but water still in plenty
	Cemented sandy conglomerate	Pluvial, waterlevel 30' higher than present
	Unconformity	
Middle Pleistocene	Boulder conglomerate Red Soil	Interpluvial, present day conditions Humid conditions
	Laterite (?)	Pluvial

Pleistocene Climatic Sequence in Western India

The Pushkar Basin

The Budha Pushkar basin, northwest of Ajmer, (Fig.8) Rajasthan contains many evidences of climatic changes during the Palaeolithic period. The prevailing southwesterly winds blow up sand straight up the valleys, which due to greatly reduced rainfall at various periods in the past, has led to the deposition of thick layers of an eolian materials. The relatively wet climate of the present time which has prevailed there probably since the end of the Pleistocene period, has generally fixed the aeolian dunes as fossil land forms. These fossil dunes provide sufficient evidence of a greater intensity of arid conditions at certain times during the past.[1]

A continuous sequence of cultural remains extending from Middle Pleistocene forward to the modern time has recently been discovered in the Budha Pushkar and Hakhra basins.[2] These have been related to various bodies of sand deposited during arid or interpluvial periods of the Pleistocene and to deeply weathered and degrated surfaces which represent more

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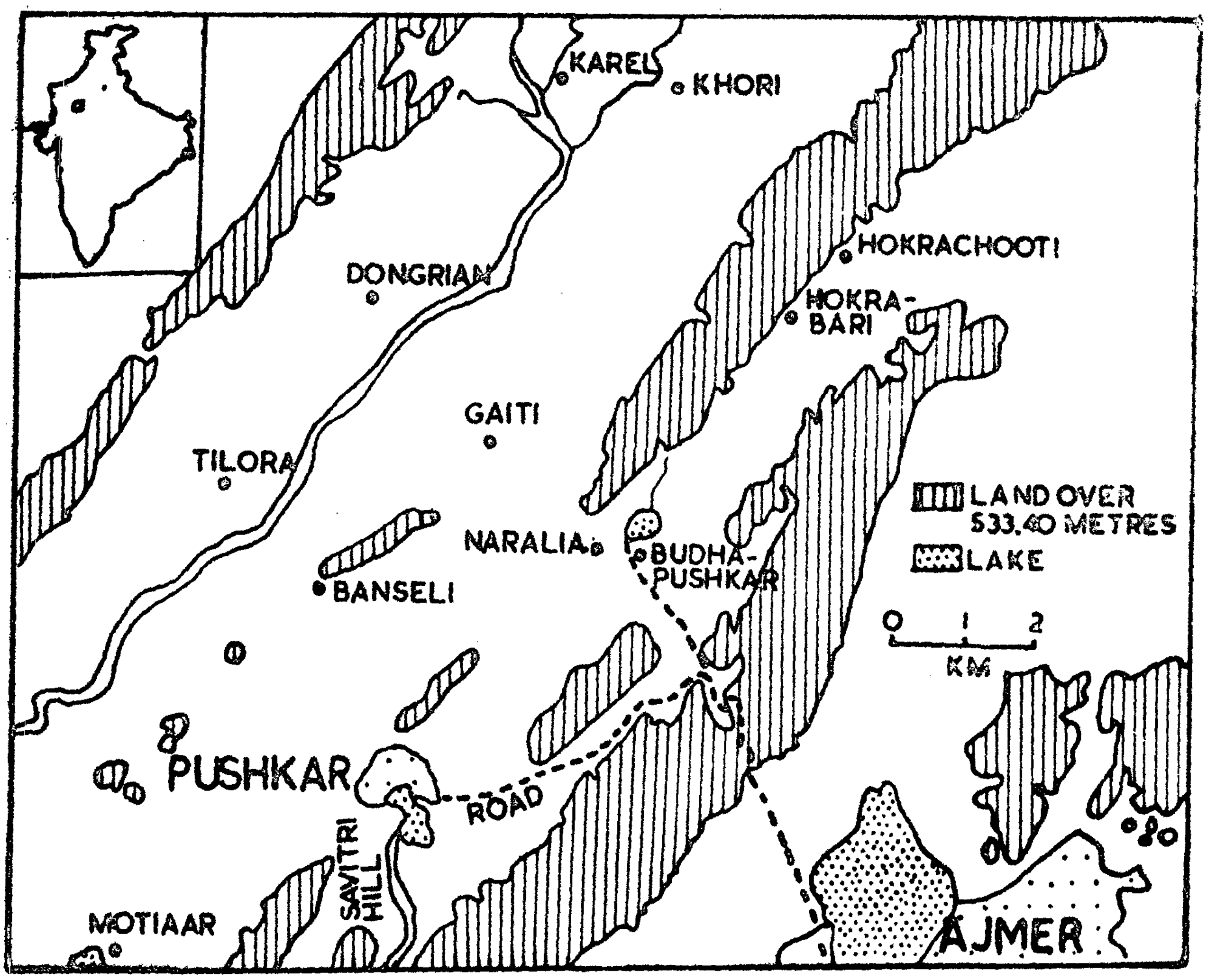
1. Goudie, A., Allchin, B. and Hegde, K.T.M., "The former extension of the great Indian Desert", J.Royal Geog. Soc., 1973, pp.243-257.
2. Allchin, B., Hegde, K.T.M. and Goudie, A., "Prehistory and environmental change in western India: A note on the Budha Pushkar basin, Rajasthan". Man, 1972, pp.541-564.

MAP OF THE PUSHKAR AREA



AFTER ALLCHIN & GOUDIE

FIG. 8

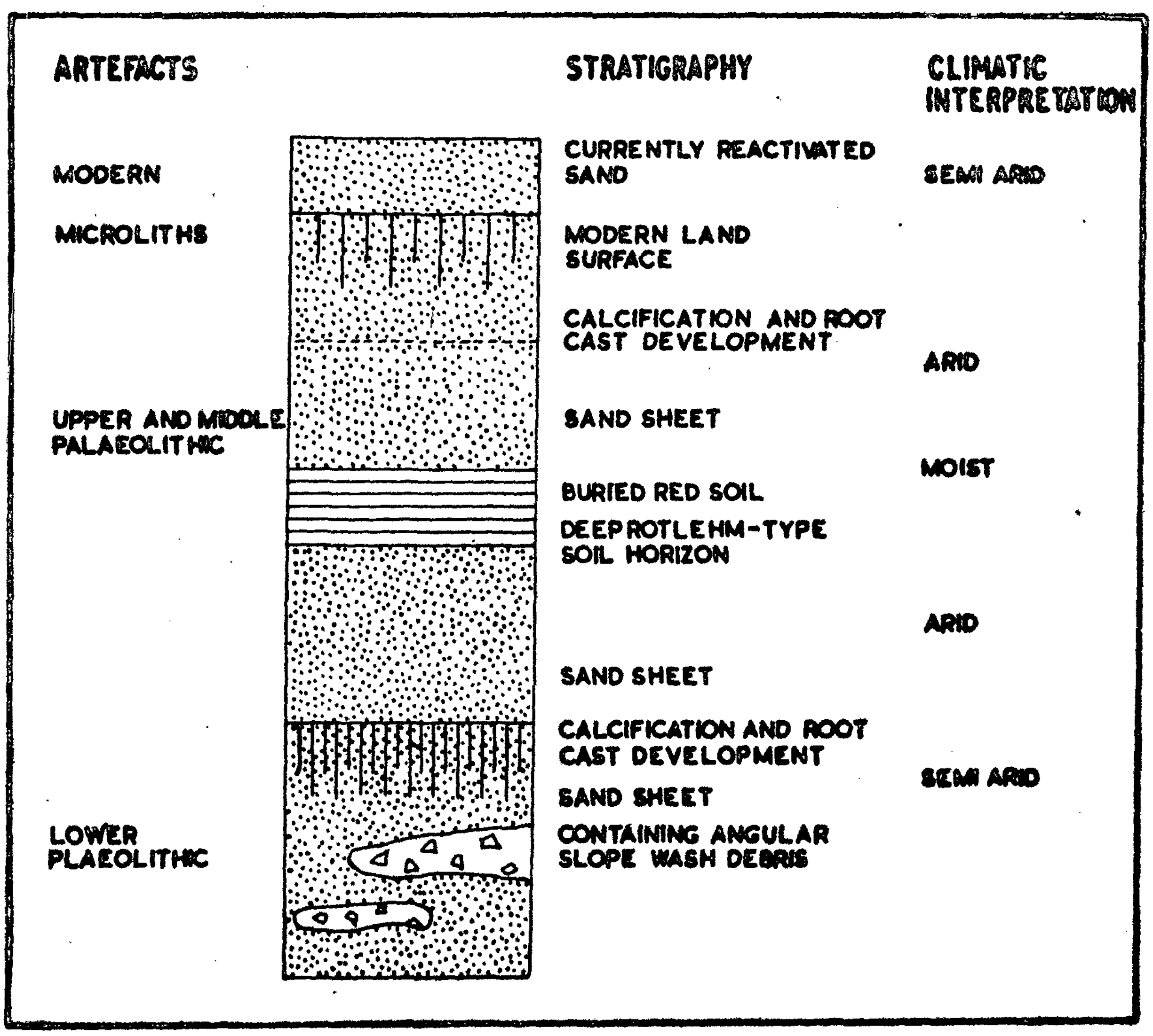
humid or pluvial climates. Similar evidences of a pluvial interpluvial Pleistocene sequence also occurs elsewhere in the Indian dry zone.[1]

The lowest layer of the aeolian deposit at Pushkar, which is non-implementiferous, consists of a widespread sand sheet capped by a well developed rotlehm- type soil profile. This soil is interpreted on the basis of chemical analysis as being the product of relatively high rainfall conditions compared with these of the present day, leading to complete decalcification, clay formation and iron precipitation.[2] The much higher rainfall as evidenced by this soil profile (Fig. 9) provided a highly favourable environment to the stone age man because on the exposed surfaces are found both Middle Upper Palaeolithic factory sites.

A major sand sheet deposited on top of the rotlehm-type surface represents an arid phase. Its surface was subsequently weathered by calcification processes under semiarid conditions which continue to the present day.[3]

1. Allchin, B. and Goudie, A., "Dune Aridity and Early Man in Gujrat, Western India", Man, 1971, pp.248-261.
2. Allchin, B. and Goudie, A., "Pushkar: Prehistory and climatic change in western India", World Archaeology, Vol.V, 1974, pp.358-365.
3. Ibid, p.364.

A SCHEMATIC INTERPRETATION OF THE LATE PLEISTOCENE STRATIGRAPHIC AND CULTURAL SEQUENCE AT PUSHKAR



AFTER ALLCHIN & GOUDIE

FIG.9

Gujarat

In Gujarat the Sabarmati, the Mahi, the Lower Narmada and the upper Godavari river systems have been studied from the view point of Pleistocene climate, chronology and archaeology.[1&2] The most important work is that on the Sabarmati system which has provided the most complete sequence. The outcrops of lateritic rock in the Sabarmati Valley are overlain by deposits of river alluvium which may reach a level of 80 feet above the present bed of the Sabarmati river. This alluvium is gravelly and in places cemented by carbonate into a solid conglomerate. Above this there lies about 20 feet of wind-blown silt and sand, overlain by the modern soil profile. The microlithic habitation site occurs on a dunes about four feet below the present soil surface and beneath this the wind-blown material is a light yellowish-brown in colour, calcareous, and contains small carbonate nodules, known as kunkar. The habitation site is indicated by a horizon that is faintly stained by humus. The existence of the buried soil suggests that during the time when prehistoric man occupied the site, the dunes were

1. Sankalia, H.D., The Archaeology of Gujarat, 1941.
2. Zeuner, F.E., Stone Age and Pleistocene Chronology in Gujarat, 1950.

stable, thus indicating a higher rainfall and less wind than prevailed before and after this period. The remains of deer amongst the prehistoric fauna support the theory that vegetation was ample and that the climate was at least moderately wet.[1] Here we can say that the climate of Gujarat was rather more humid than it is today. The rivers had already excavated their valley to the depth at which they are now flowing, further Prof. Zuner discovered that this period was followed by one of drier conditions. Infact, the deposits which/ were found on the banks of the Sabarmati have shown thatthe climate became increasingly drier for some time and that the river valley was filled with wind-blown dust that they raised their beds on the accumulating sandbanks. They were dry for most of the year, but when it did rain, they flooded the adjacent lands. After this period of dryness, we might almost say desert conditions, the climate again became wetter and forests once more covered the country. This period seems to have lasted for some time, but it too, was followed by a period of dry conditions. Again the Sabarmati and other rivers spread sand and fine gravel over the countryside. Wind began to play with the sand and dunes

1. Clutton-Brock, J., Excavations at Langhnaj, pt.II, The Fauna, Deccan College, Poona 1965, pp.1-2.

heaped up in many places. Thus even today wind-blown sand deposits form the sub-soil of Gujarat.

The desert period was succeeded by a damper phase, when forests again spread over the country. The sands were thus caught and fixed by vegetation. It was about that time that man of a much later cultural stage lived in this area. Remains of these people, both implements and the skeletons, were discovered and excavated at Langhnaj by Prof. Sankalia. The interesting feature of this period is that, while man was living there, the climate became drier once more and the sands were blown about. But this was a short interlude, after which the forests came again.[1]

It is now clear that Gujarat underwent repeated oscillation of climate between pluvial and interpluvial conditions during much of the Pleistocene. During this period the laterite beds were being laid down and which starts the sequence, the rainfall was high enough to be legitimately called a pluvial phase. It is as yet uncertain whether this pluvial phase immediately preceded the implimentiferous gravels or with long interval. Conditions then successively became moderately humid, drier again moderately humid and once more drier until they oscillated around present day conditions/ (Fig.10)[2]

1. Zeuner, F.E., Prehistory in India, Deccan College Handbook Series: I, Poona, 1951, pp.7-8.
2. Zeuner, F.E., op.cit., p.42.

SECTION AT PADHAMLI ON SABARMATI

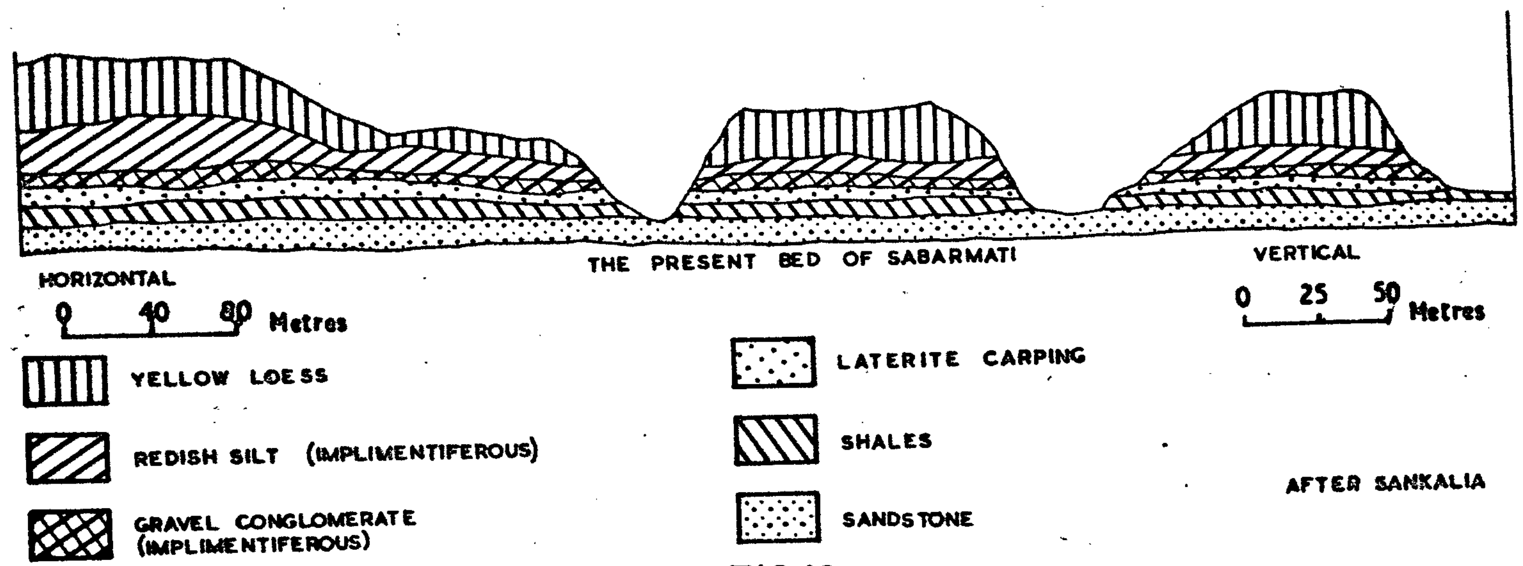


FIG.10

Pleistocene Climatic Sequence in Eastern India

Mayurbhanj

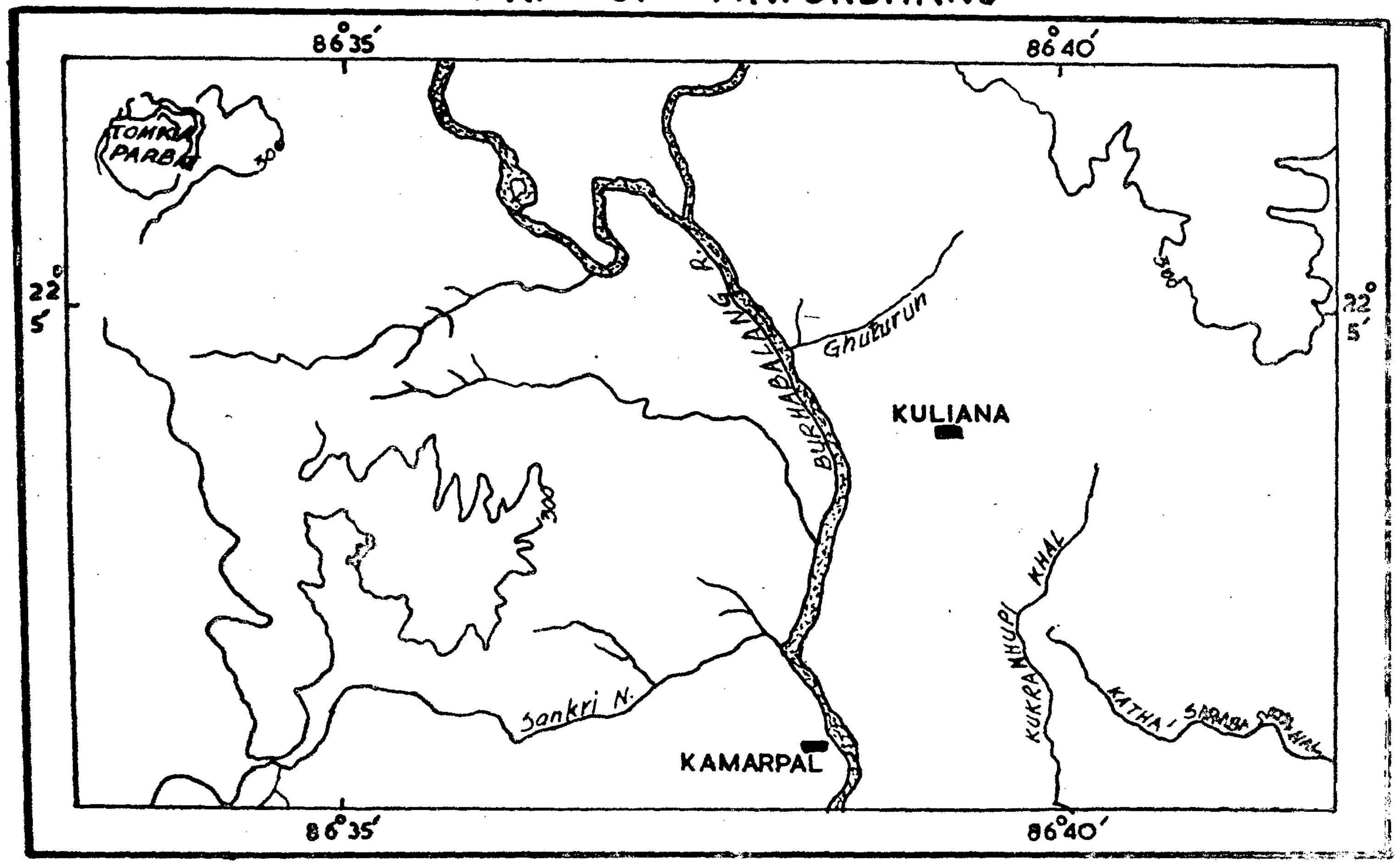
Bose and Sen have studied some sections of the implement bearing secondary laterite of Kulina near the village Kamarpal on the Burhabalang river in Mayurbhanj.[1] (Fig.11). After careful observations they came to the conclusion that the section reveals repeated oscillation of climate between relatively damper and drier conditions during much of the Pleistocene.

There are a number of good sections exposed along the right bank of the river Burhabalang both up and down the stream, near Kamarpal village. For our problem the three sections between Kamarpal Ghat and the Sankari Nala, a distance of about a mile, are important. They are as follows:

Section 1: This is within half a mile upstream of Churgunia Ghat near the confluence of the river with a small nullah. The lowest exposed bed is a bed of greyish white sticky clay of unknown depth. The colour is more yellowish near the top than lower down. Above this bed is a gravelly laterite bed,

1. Bose, N.K. and Sen, D., "Climatic Changes during the Stone Age in Mayurbhanj", G.R.I., Vol.XIII, 1951.

MAP OF MAYURBHANJ



AFTER BOSE

FIG. 11

thickness of which is 3 feet 9 inches. This bed has a typical ferruginous lateritic appearance, with characteristic vermicular structure. The next bed above this gravelly laterite is a bed of Boulder conglomerate which has been termed Lower Boulder conglomerate in order to distinguish it from another Boulder conglomerate bed which overlies it after an interval formed by a layer of clay with sand and gravels. The thickness of this bed is about 3 feet 6 inches. The matrix shows some concentration of ferruginous material. The sandy clay overlying the lower Boulder conglomerate is 1 feet in thickness and contains gravels of various sizes. The overlying bed is again of Boulder conglomerate, the thickness being 3 feet 8 inches which has been termed as Upper Boulder conglomerate. The matrix shows some concentration of ferruginous material. From the lower portion of this bed one core tool was found. The top most bed in the series is formed by a thick deposit of alluvium overlying the Upper Boulder conglomerate. In this section a large portion of bed has been washed away by rain. This top soil has been termed Old- alluvium and there is a narrow pebbly band near its middle. Even the present day high floods do not reach the top of this bed.[1]

1. Bose, N.K. and Sen, D., ibid., pp.1-8.

Section 2: This section is located farther downstream. The yellowish clay and a portion of the compact gravelly laterite is under water. The laterite exposed above water is 1 feet in thickness. Then comes the Lower Boulder conglomerate having a thickness of 4 feet. In the upper portion of this bed a pebble tool was discovered. The bed overlying the Lower Boulder conglomerate has a peletty lateritic structure, in which pebbles are embedded. In thickness it is 2 feet. Then comes the Upper Boulder conglomerate, the thickness being 5 feet 6 inches. In the lower horizon of this bed an insitu crude handaxe was found. Both the tools from this layer show signs of rolling. In this second section the top most bed has a thickness of 10 feet. There are indications that a portion of this alluvium has been washed away.

Section 3: This section located between section one and two (discussed above) is nearly identical with the previous two in character. Excepting for the thickness of the old-alluvium, the thickness of the other beds are nearly the same as in the two sections. Here the topsoil is almost intact, the thickness being 25 feet 6 inches.

Geological observations give the idea that the outcrop of the lowest grayish clay bed in the sections near

Kamarpal is of the same appearance as the "thinly stratified greyish white or very pale clays" found above the ostrea beds at Mahulia near Baripada,[1] which is of Miocene Age. The limestone bed at Mahulia which is known as Baripada bed and was assigned to Lower-Miocene period by P.N.Bose, has been restudied and assigned to Lower-Pleistocene instead of Lower-Miocene by K.C.Sharma[2] in his paper.

In the year 1955 a few fossils (molluscs, shark teeth, etc.) were discovered from the shale band above lime-stone of Baripada beds at Mahulia and Mukramatia. Among the fossils collected at Mukramatia, there occurs a bovid tooth.[3] These fossils provided the most valuable proofs for Sharma's theory for its early Pleistocene data.

Geologists are of the opinion that laterite is a product of sub-aerial weathering of various types of rocks. So the compact gravelly laterite in our sections which at present remains under water almost throughout the year must have been a land surface above permanent ground water level

1. Bose, P.N., "Notes on the Geology and Mineral Resources of Mayurbhanj", R.G.S.I., 1904, Vol.XXXI, pt.3, p.167.
2. Sharma, K.C.,'On the Palaeontology of the Baripada Beds, Mayurbhanj, Orrisa', Quar. Journ. Geol. Min. Met. Sec. of India, Vol.28, 1956.
3. Choudhury,A.,"Pleistocene Pluvial Cycle and its Correlations" Proc. Ind. Sci. Cong., 1956, March, pt.IV. (Discussion).

when it was actually formed. Here we may quote C.S. Fox's opinion[1] on the formation of laterite in peninsular India. It requires "conditions of weathering under humid tropical climates above permanent ground water level from rocks of suitable constitution and texture."

The deposition of the Lower Boulder conglomerate suggests a heavy fluviatile condition. The concentration of ferruginous material in the clay bed above it which has turned into pellety laterite with pebbles in places suggests again a sub-aerial exposure, i.e., a time when the water level must have sunk again.

A heavy fluviatile condition is also suggested by the Upper Boulder bed. The thick deposit(6 feet in thickness) of old alluvium at the top suggests normal flow of water with a low velocity. But the narrow pebbly band within this alluvium at about its middle might once more point to a minor increase of water flow for a short period.

The fact that the Burhabalang now normally flows at a level which is far below the old alluvium and never reaches the top level of that bed even in high floods, definitely proves that the river was subjected to a process

1. Records of the Geological Survey of India, Vol.LXIX, part 4, p.391.

of rejuvenation subsequent to the deposition of the alluvium, that is why the term old alluvium has been used to designate it.

With regard to the Boulder conglomerate beds and the lateritized matrix at certain levels, the only possible explanation seems to be that the lower compact gravelly laterite bed and the upper pebbly laterite represent two old land surfaces. These are separated from one another and from the old alluvium by Boulder beds which indicate a large carrying capacity of the stream. It is now suggested that the whole series was due to a succession of pluvial and dry conditions than to large-scale tectonic movements.[1]

After all these observations we come to the conclusion that the climate of Mayurbhanj was characterised by relatively damper and drier conditions during much of the middle and upper Pleistocene period.

Pleistocene Climatic Sequence in the Madras Region

The Palar Plain round Madras is characterised by a spread of detrital laterite which is underlain at certain

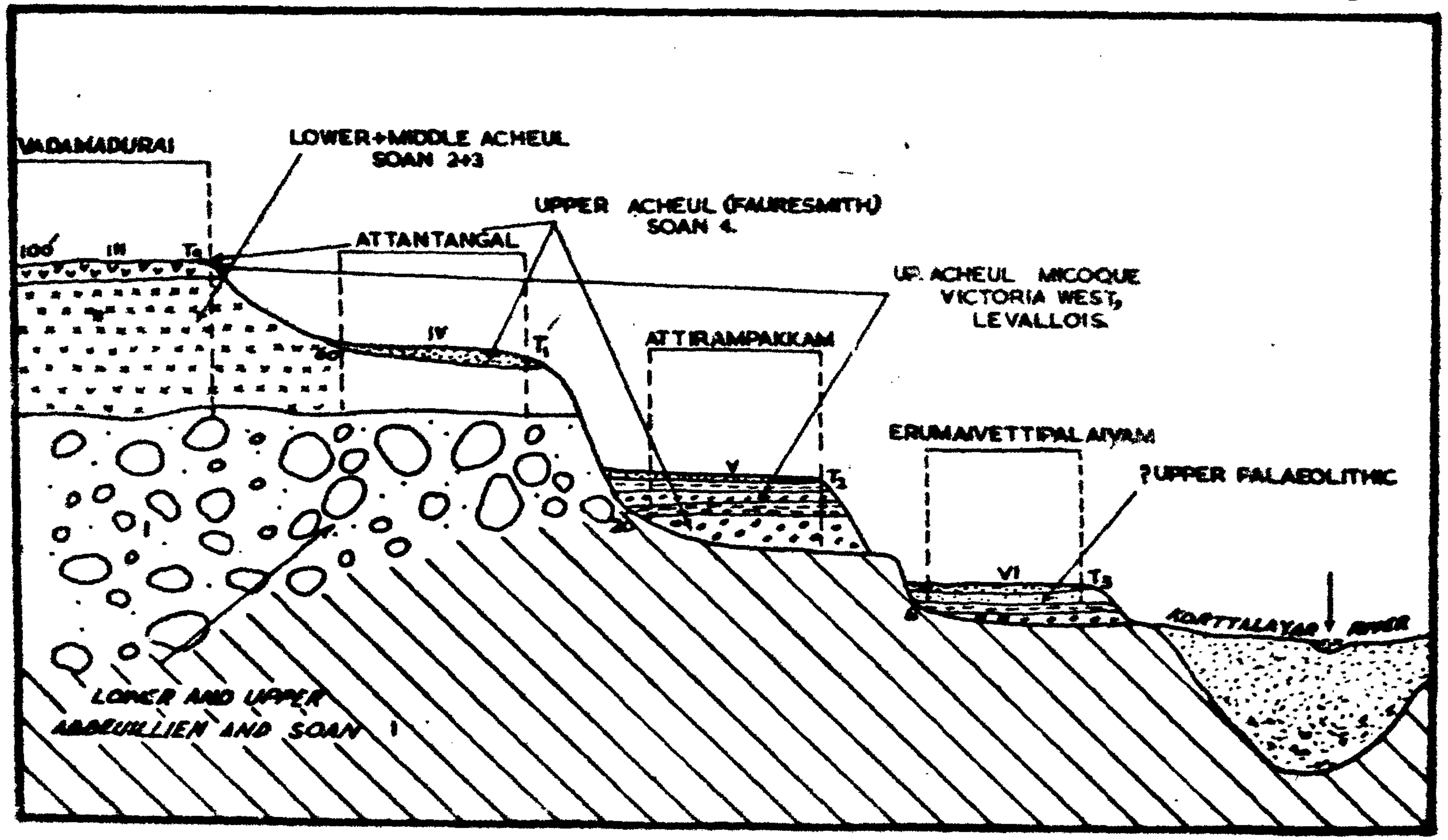
1. Bose, N.K. and Sen, D., "Climatic Changes during the Stone Age in Mayurbhanj". Geographical Review of India, Vol.XIII, 1951, pp.5-6.

places by a Quaternary Boulder conglomerate overlying pre-Tertiary formations. On archaeological grounds this has been correlated with the Mid-Pleistocene basal Narmada zone and with the Mid-Pleistocene sequence starting with the Boulder conglomerate zone of the Potwar. Here the laterite peneplain is cut by the prominent river (Kortalayar or old Palar), into a series of four terraces: the 100' laterite depositional terrace T_0, a 60' terrace of a thin mantle of alluvium followed in turn by two clear terraces 20' and 8' respectively above the present valley floor. These terraces are well represented at Vadamadurai, Attantgal, Attirampakkam and Erumaivettipalaiyam respectively in the Kortalayar Valley.[1] (Fig.12).

The laterite peneplain at Vadamadurai has not yet been climatically dated, but on the basis of correlatable similarity between the archaeological records of the Narmada and Potwar regions, the age of T_1 of the Soan Valley (second Interglacial) has been assigned to Narmada basal conglomerate. If this dating is correct then the detrital laterite would also come under the Mid-Pleistocene second interglacial which is degradational in origin. Thus we

1. Krishnaswami, V.D., "Stone Age India", Ancient India, Bulletin of the Archaeological Survey of India, No.3, January 1947, pp.32-33.

Composite section of the Kortalayar Valley correlated with Palaeolithic cultural stages



AFTER KRISHNASWAMY

FIG.12

can say that the Boulder conglomerate underlying the implementiferous detrital laterite of T_0 of Kortalayar Valley represents a violent pluvial phase during early Pleistocene. Subsequent phases, represented by the four terrace of the valley, imply not only fluctuations of climate between wet and dry phases but a monsoonal affect as well which is the general condition essential for laterite formation in tropical climate, subject to highly contrasted alternation of dry and wet season.[1]

The two terrace stages near Madras can be climatically interpreted.[2] The first terrace is degradational in origin and indicates a dry phase for the period during which it was being formed. The second terrace, at Attirampakkam, is aggradational and corresponds to a pluvial phase of climate. The third and the last terrace is presumably erosional and indicative of a dry phase. Thus the Pleistocene cycle in Madras region indicates a fluctuating climate, alternating between wet and dry phases. The four Pleistocene terraces[3] correspond to four cycles of sedimentation of which the first and the third are clear pluvial periods of strong intensity corresponding to T_0 and T_2.T_1 and T_3 probably represent interpluvial phases.

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1. Pascoe, E.H., A Manual of the Geology of India and Burma, Vol. III, 1933, pp.1975-76.
2. Krishnaswami,V.D.,"Changes of Prehistoric Man near Madras", JMGA, 1938, pp.58-92.
3. Krishnaswami,V.D., Ibid., p.70.

Pleistocene Climatic Sequence in the Inland Region of Deccan

For the inland region of Deccan Burkitt[1] has built up a.Pleistocene climatic cycle. The Middle Pleistocene first witnessed a dry phase which was followed in turn by a violent pluvial phase and then again dry phase. The Upper Pleistocene was a period of humid pluvial conditions which were succeeded by a dry phase during the Post Pleistocene period. Thus a climatic cycle for the Pleistocene, consisting of seven pluvial and interpluvial periods, emerges for the inland region of Deccan.

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1. Burkitt, M.C. and Cammiade, L.A., "Climatic changes in South-east India during Early Palaeolithic Times." Geological Magazine, Vol.LXIX, May 1932.

TABLE V

Sequence of Climatic and Cultural Changes of the Stone Age for the Inland Region of Deccan after Burkitt.

Climate	Deposit	Industry
Dry phase followed by denudation leading to the present conditions VI - VII		Slender blades and microliths
Humid pluvial, not as strong as I and III V	No laterite alluvium of river deposits	Flake industries
A secondary dry period IV	Settlement on newly formed gravel and clay	Handaxes servive, flakes come in
A period of violent rainfall III	Flat sheets of river gravels formed	Early Handaxes come to an end
Dry period II	Forests of the laterite gave rise to open plains	Early Handaxes settled on these plains
A long damp period I	Gave rise to laterite on the east coast between the rivers Kistna and Palar	No human relics

The following observations[1] of Drs. Hora and Banerjee may also be considered in connection with the general behaviour of climate of peninsular India.

Thus the aridity of the Deccan plateau between the two ghats seems to have occurred again and again during the interglacial periods of the Pleistocene. During the pluvial periods, the plateau became higher relative to the sea-level owing to the eustatic movements of the sea, the temperature was considerably lower and the humidity higher. Such conditions favoured the growth of thick, evergreen, deciduous vegetation all over the plateau. During interglacial periods, owing to dessication due to high temperature and low rainfall, the once continuous faunas and floras developed into new varieties, species or genera according to the nature of the ecological conditions to which they became subjected.

If this hypothesis of the sequence of climates in peninsular India be accepted it seems that the pendulum of the climate was swinging constantly from semi-arid to humid phases during the Pleistocene period.

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1. Hora, S.L., "Significance of the semi-arid tracts of the Deccan Plateau in the distribution of Plants and Animals", Symposium on the Semi-Arid tracts of Peninsular India and their development, National Institute of Sciences of India, 1952, p.25.

Pleistocene Correlation and Chronology in India

Chronology is a most important aspect of Pleistocene geography. The perspective of time is equally as important to the cultural geographer as to the geologist. There is no doubt that man has existed in India for hundreds of thousand years - atleast since the Mid-Pleistocene time. To assess the cultural and biological evolution of man during the Pleistocene, one should have some general idea of Pleistocene chronology.

Geophysical measurements suggest that previous estimates of the total time span of the Pleistocene archaeological record were too short by a factor of 3 to 4. Studies of palaeomagnetic reversal of Eriscon's deep sea cores by Glass place the beginning of the Pleistocene to about 2 million years. The estimates however vary greatly. Emilliani, on the basis of oxygen isotope analysis of sea sediment cores has estimated the base the glacial Pleistocene at 300,000 to 425,000 years B.P. Palaeomagnetic studies in Iceland and pottassium-argon (K-Ar) dates have dated the Plio-Pleistocene boundary to 3 million years. But recent works have tended to agree with Eriscon's estimates.[1] It

1. Agrawal, D.P., Prehistoric Chronology and Radio Carbon Dating in India, 1974, p.33.

should however be pointed out that the most frequently accepted consensus still places the Plio-Pleistocene boundary at about 1,000,000 years B.P.

In Africa all known Lower Pleistocene artifact occurrences can be assigned to the Oldowan Industrial Complex and a time range of 2.5 to 1.5 million years is indicated for these industries. Similarly in Africa and Circum-Mediterranean Eurasia, the oldest occurrences assignable to the Acheulian Industrial Complex fall very early in Middle-Pleistocene, i.e. 1-1.5 million years ago.[1]

In the past two decades, developments in geophysical techniques have made the calibration of the passage of time in prehistory possible, as has been mentioned above. But unfortunately in India the absence of exhaustive work on K-Ar and C^{14} dating, there is considerable confusion regarding the calibration of the Plio-Pleistocene boundary and other important events. There is no tangible basis for dating Early Stone Age, though there are few C^{14} dates available for Middle Stone Age. The Late Stone Age and the Neolithic is better dated. These are the formidable problems one

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1. Glynn LL. Isaac, "Chronology and Tempo of cultural change during Pleistocene" in <u>Calibration of Hominid Evolution</u>, (Bishop & Miller, Edit), 1972, p.385.

encounters while dealing with Indian Stone Age chronology. However it appears that Early Stone Age, which in India can be assigned to the Mid-Pleistocene period, started about a million years ago.[1] There is also some evidence to suggest that the final deglaciation in the Kashmir Himalayas occurred about 14000-15000 years B.P.[2] This date is in agreement with the dates generally associated with deglaciation following the last glacial period in several parts of the World.

Krishnan[3] has given a framework of Indian Pleistocene chronology which can be used untill a better chronology is developed based on K-Ar and C^{14} dating.

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1. Agrawal, D.P. and Kusmgar, S., op.cit., p.151.
2. Singh, G. and Agrawal, D.P., "Radio Carbon Evidence for Deglaciation in North-Western Himalaya, India", Nature, Vol.260, 1976, p.232.
3. Krishnan, M.S., Geology of India, 1968, p.502.

TABLE VI

Chronology of Quaternary Age in India

End of the last glacial	15,000 years ago
Beginning of IV glacial	1,50,000 years ago
III inter-glacial	2,50,000 years ago
III glacial	3,00,000 years ago
II inter-glacial	4,00,000 years ago
II glacial	5,00,000 years ago
I inter-glacial	8,00,000 years ago
I glacial	10,00,000 years ago

Pleistocene Correlations

The pioneering work of the Yale-Cambridge expedition of 1936 under de Terra, Paterson and Teilhard sought to provide a much needed geological context for the Indian Stone Age studies. Their work also provided a working basis for chronological correlation with other parts of the country. However, for obvious reasons, these farflung correlation between the peninsula and North India should not be taken as an established fact. A really satisfactory and scientific Pleistocene correlation in India must await a concerted, multi-disciplinary systematic work using K-Ar, C^{14} and other modern dating techniques. Pending this development de Terra's scheme of correlation can be taking as a working hypothesis for the study of the time-stratigraphic context of the Indian Palaeolithic cultures.

As has been explained earlier, the Kashmir Himalayas, were subjected to multiple glaciations during the Pleistocene, de Terra's expedition established a glacial chronology in the Kashmir Himalayas. A chronology for the peri-glacial Punjab plains was also worked out in terms of the Kashmir glacial cycle by continuing the traverses of the Pirpanjal into the foothills and thence into the plain, thus tracing the relationship of the glacial deposits with the alluvial sediments of the Potwar region.

Since the Boulder conglomerate zone of the Upper Siwalik merges directly with the moraines of the second Kashmir glaciation, this according to de Terra provides a direct and independent correlation between the Boulder conglomerate zone and the cycle of glaciation. It provides a firm basis for the establishment of an archaeological chronology not only for the Potwar area but also for the rest of the country. The correlation of the glacial cycle with the cycle of sedimentation in the Potwar region as well as with other regional sequences have been dealt with appropriate sections of this study.

CHAPTER II

STONE AGE TOOLS: THEIR TYPOLOGY, TECHNIQUE, RAWMATERIAL AND FUNCTION

Tools are to the students of man what fossils are to the students of life in general. From them one can learn a lot about the manner and habits of their makers. They are records of a most intimate nature and in their totality reveal much more about a vanished people than all the books that might have been written about them. Pre-historic tools survive to illustrate the practical knowledge possessed by their makers. At the same time they also represent application of socially approved discoveries and inventions and socially approved needs. They disclose not only the level of technical skill attained but also the manner in which their makers got their livelihood, their economy.

The records of man's first attempts for shaping any environmental object to satisfy his specific needs are perhaps lost for ever, as they were made on perishable organic objects. However, the fact that man soon started experimenting with stones for making tools is evidenced by the phenomenon that in all pre-historic artifact collections discovered so far these stone tools have continued to form, almost in a persistent traditional manner, an overwhelming percentage.

The use of stone for implements, therefore, is extremely ancient and as the raw material is also found in some form or other almost every where its products have hitherto naturally served as guide forms and as the chief source of archaeological classification. In spite of its apparent refractory nature, it is capable of being worked in a variety of ways and its products, therefore lend themselves readily to technological, typological and chronological interpretation. The attribute of plasticity or workability inherent in ordinary stone enables their resulting products to serve as a fairly authentic guide. They present genetically related series constituting gradually specialized form groups.

TYPOLOGY

Typology is concerned with the classification of artifacts, and just as the stratigrapher attempts to make order out of a welter of cultures, so the typologist tries to classify all the various implements into groups or families. For this purpose two methods may be followed or rather more strictly speaking, two considerations must be always kept in mind. To begin with the form of the tools must be noted, together with any characteristics which appear from the frequency of their occurrences to have been definitely intended by their makers; while at the same time the method of manufacture of the tools must not be lost sight of, for even when making the same kind of tool peoples belonging to different cultures did not always do so in exactly the same way. The importance of this latter consideration has only recently been sufficiently recognized, but it is proving more and more useful to the typologist.[1] The study of typologies of pre-historic tools is mainly aimed at establishing the different tool-making fashions practised by prehistoric man at different places in the initial phases of his cultural development. For the later periods the typological study helps us to identify the diffusion, contact and migration of different traditions of the past cultures. As such certain very clear-cut structural or morphological definitions have been given to classify the various kinds of tools coming from all ages. It should in no way, mean that all the tools found from all over the world have to conform to any of these defined typologies. This is mainly because prehistoric men worked according to their plan and necessities (as mantioned earlier) without having anything to do with our attempt of defining some common kinds. As

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1. Burkitt, M.C., <u>The Old Stone Age</u>, 1956, pp.26-27

a result, within a typology many stylistic variations are noted and, as a rule, they are described on the basis of specific pecularities. For instance, the word hand-axe stands for a defined typology. But if anybody finds a handaxe with some pecularity which he wants to describe, he can always record triangular handaxe, ovad handaxe, cordiform handaxe, pyriform handaxe and the like. Before we commence with the definitions of various typologies, it is important to note that many cultures with characteristics tools have, in the course of time, developed almost typological meaning. For instance, it is not unusual to come across such expressions as 'Abbevillian handaxes' in the archaeological literature on India. It would, therefore, be worth while to describe here even these typologies and their meanings. The following are the typologies commonly met with in the Palaeolithic culture.[1]

PEBBLE TOOL

Literally the term will apply to any tool made on a pebble but by usage it has come to be restricted to a class of scrapers, choppers and hand-adzes in which only the working edge is flaked and the remaining part of the tool is untouched. Since such tools were first found from Olduvai in Africa,

1. Bhattacharya, D.K., Pre-Historic Archaeology, 1972, pp.31-32.

these are referred to as Olduvaian tools. These tools are generally quite big and massive and are made by flaking a suitable river pebble. Starting with an elongated pebble, the edge of one surface was sharpened by striking it against another stone according to block-on-anvil technique. The rest of the surface of the pebble was not worked upon. In some cases, flakes were removed from both the surfaces from one end of the pebble. These usually reveal a very sinuous cutting edge. Movius H.J. in 1944, while analysing the palaeoliths from India,had recommended the term chopper for unifacial pebble tools and chopping tool for the bifacially worked ones. The majority of both the chopper and chopping tools have a more or less transverse cutting edge. However numerous choppers tending towards a pointed cutting edge are also ascribed within pebble tools. Paterson and Drummond in 1962 while redescribing some Indian palaeoliths have recommended the use of the term pointed oblate for pointed pebble tools with minimum flaking.

ROSTRO - CARINATE

It is a kind of pebble tool in which the cortex or pebble's original surface on a part of its back side was retained. The front surface was also partly untouched near the butt-end. Very few deep flakes were removed from this surface towards the working end. The flaking towards the end is so abruptly steep that in profile this appears as a keel like elevation. ~~(Fig.D)~~

PROTO - HAND-AXE

This is only a variety of the rostro-carinate. Here one surface of the tool, as a rule, is found not worked upon, while a few flakes were knocked off the other side to give it a cutting edge. On comparative grounds a proto-hand-axe is better-shaped with more flakings done than a rosto-carinate. However in both the cases secondary working is rare.

HAND-AXE

It is a core tool made with unifacial or bifacial flaking. In profile usually it is biconvex. As a rule the butt-end is thick and heavy, while the working-end tapers or slopes down to form a pointed, sharp edge. It may or may not have some areas of untouched cortex. The term chellian and abbevillian are sometimes used for describing handaxes with deep flake scars and irregular outline indicating and early stage in the handaxe industry. These terms are after sites in France. The term acheulian, similarly, has come now to signify a very advanced stage in the development of handaxe culture and stands for symmetry of form produced by a certain technique. It must be emphasized here that outside France the term Abbevillio - Acheulian has little chronological significan, though it is true that in India as well as in Africa handaxes do show a gradual improvement which may correspond with the Abbevillian and Acheulian. However in India at least no stratigraphical evidence is yet available to show the various stages of development.

There are many kinds of hand-axes identified according to their shape and technique of manufacture. Some common types of hand-axes are:

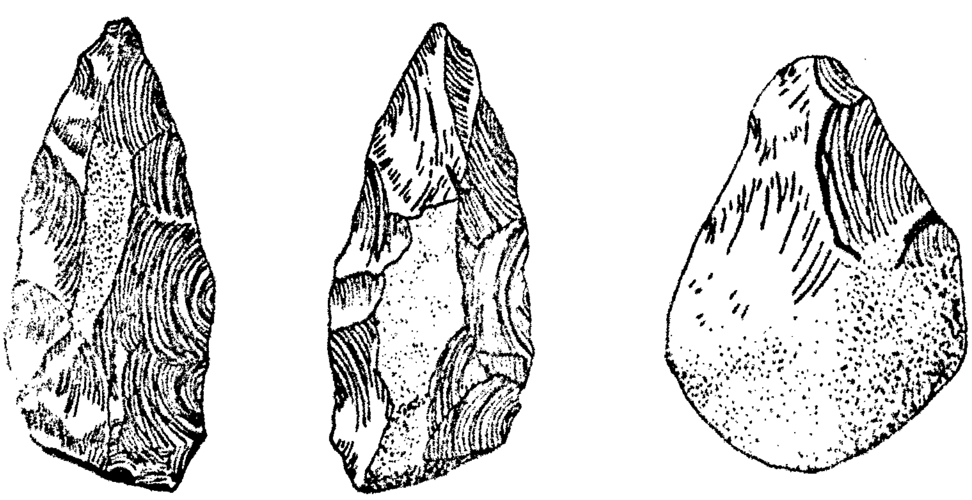
(1) Pear - Shaped or Pyriform

As the name would suggest this is a specific kind of handaxe and resembles the shape of a pear and not just any handaxe which may have a pear-like shape. It is a short heavy handaxe with rather a rounded point at the working edge. Usually the butt-end is found unflaked and the sloping of the two borders to be very gentle, the general shape is given by primary flaking accompanied by detachment of only a few secondary flakes to sharpen the edge (Fig.13).

(2) Ovate

It is an advanced variety of handaxe which is oval in shape. The tool though biconvex in profile is thin and

PEBBLE BUTTED HAND AXE SHOWING ABBEVILLEAN TECHNIQUE



TRIANGULAR HAND AXE

PEAR SHAPED HAND AXE

FIG. 13

symmetrical. The working end and the lateral borders continue in the form of a ridge across the butt-end. Secondary trimming is done all over the border and a regular working border is formed. In many instances, when looked in the profile the lateral border of the tool appears like an extended S. This is known as the S - twist or ovate with a characteristic S - twist.

(3) Lanceolate

This type of handaxe has fairly long tapering or sloping sides ending into a pointed end. The surface is found rather flattish as a result of probably well-planned controlled flakings. The width of the tool is always shorter than the length. This is also one of the symmetrical and well-finished varieties of handaxes.

(4) Cordate

It is so named because of its similarity with the shape of the heart. The butt-end is well rounded and curves gently into the sides to meet at the working end. The work-manship in the execution of the flakings in this typology is as advanced as observed in the ovate and lanceolate types of handaxes. (Fig.14).

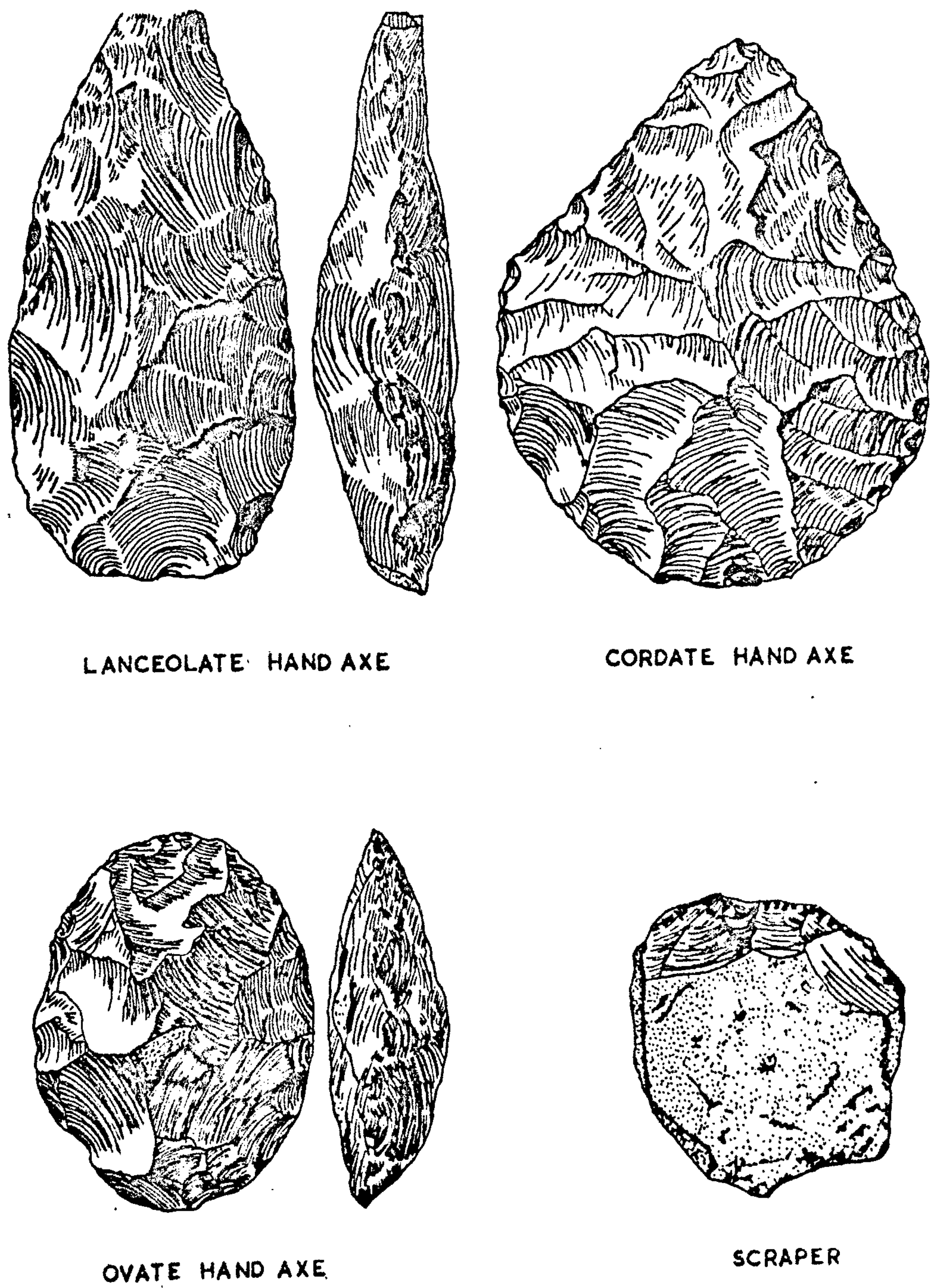

LANCEOLATE HAND AXE
CORDATE HAND AXE
OVATE HAND AXE
SCRAPER

FIG.14

CLEAVERS

This is a flake tool made on a broad, rectangular or triangular flake. In a few cases, these implements are made on a core as well, but if worked bifacially, the distinction between a core and a flake is not possible. The under surface of the tool retains the primary flake scar while the upper surface may retain a portion of the original surface. Generally speaking, the upper surface is flaked all over and the final large, flat scar removed at the broad end of the flake intersects with the scar of the under surface to give rise to a broad and straight cutting edge. The two longitudinal sides which are comparatively thick, are trimmed possibly to facilitate holding. Cleavers are further subdivided into characteristic types on the basis of the shape of their butt-end, form of the edge and nature of the cross-section.

SCRAPERS OR RECLOIRS

These are usually smaller tools made, in most of the cases, on a medium-sized flake. Unlike handaxes and cleavers where grip and force is mainly supported by the palm of the hand during manipulation, a scraper is a tool essentially manipulated by fingers.[1] As the name indicates,

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1. Bhattacharya, D.K., Pre-historic Archaeology, 1972, p.37.

these are ordinarily meant for scraping such things as barks of trees, dressing of thin wood or bamboo shafts and skins of animals as well as for various cutlery purpose. According to the shape of a particular piece, and the position and nature of the edge for scraping, the tool is named as:

(i) Side Scraper

Here one of the longer side is obliquely retouched from the upper or under side and forms the principal scraping edge, and the opposite side provides a hand-hold or is naturally suitable for holding.

(ii) End Scraper

In this tool type, the edge, made obliquely from the upper surface on a thick flake or nodule with a flat under surface is, on the shorter side or end. This is often steep. Hence the tool is also called "Nose Scraper", because the end or side having the edge is steep like a nose.

(iii) Round Scraper

Some times, circular or oval flakes are sharpened nearly all round by careful trimming. Thus called round or thumb scrapers.

(iv) Convex Scraper

In this the nodule may be of any shape or thickness, the main working edge is convex or arched and obliquely retouched from above or the under surface.

(v) Concave or Hollow Based Scraper

In this a large or small concavity has been made either naturally or intentionally in one of the sides of the sloping surface of the flake by the removal of a flake. This concavity is obliquely retouched from the upper or the under surface. In rare cases one may notice such retouch on both the surfaces.[1] (Fig.15).

POINTS

Points are almost of the same size as the scrapers i.e., seldom exceeding 6 inches. Unlike scrapers where a general slope is formed from the back border to the scraping border by flaking, in points there appears a slope of similar kind obtained for two opposite borders. Thus the central region is a little elevated than any of the borders. These two borders converge in a anterior part to give rise

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1. Sankalia, H.D., Stone Age Tools, Their Techniques, Names and Probable Functions, 1964, pp.61-62.

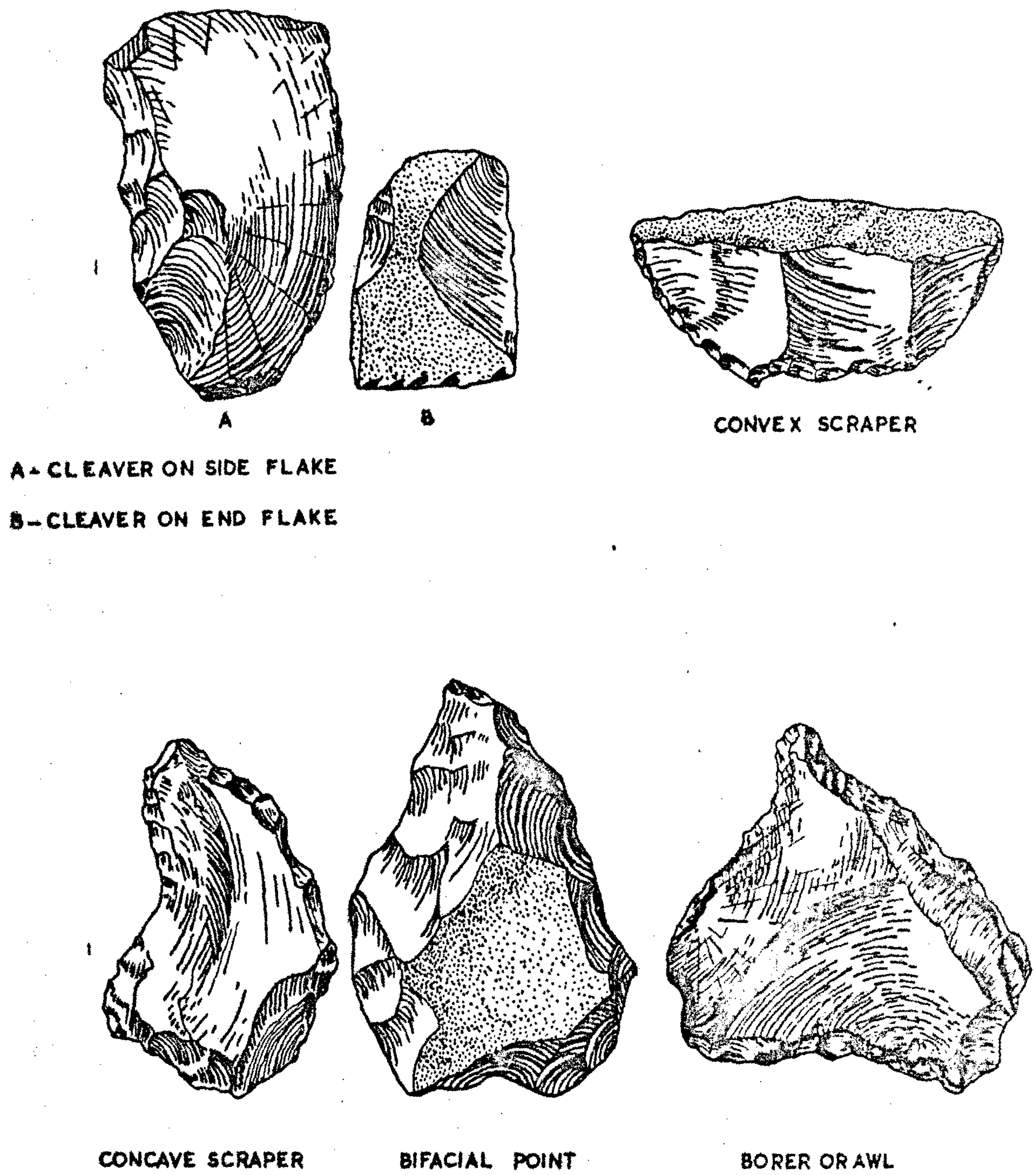
A
B
CONVEX SCRAPER
A - CLEAVER ON SIDE FLAKE
B - CLEAVER ON END FLAKE
CONCAVE SCRAPER
BIFACIAL POINT
BORER OR AWL

FIG. 15

to a point. This is further enhanced by secondary retouchings near the pointed end. The base of the point, as a rule is thicker. In many cases, the under surface is also flaked in order to make the tool light and thin. A point consisting a single corner removed from the base by a single below is called a 'single- shouldered point'. In some cases the opposite corner also occurs flaked off and such tools are called 'Double Shouldered' or 'Tanged Points'.

DISCS

These implements are round, oval or roughly square with very irregular edges. They consist of pieces of flint trimmed all over, the intersections of the trimmings of upper and lower faces forming the sharp edges.[1]

BORERS OR AWLS

These consist of implements usually made on flat flakes but sometimes also on convenient nodules. It has a thick projecting point with two notches made on either side of the point. This does not require any further retouchings on the surface and as such are often made on the corner of any convienient flake.

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1. Burkitt, M.C., The Old Stone Age, 1956, p.62.

BURINS OR GRAVERS

This is an advanced palaeolithic tool type and as the name would signify it was specifically made to serve the function of engraving. It is a chisel- like tool on a small blade- like flake. It has a sharp and straight cutting edge almost comparable to the working edge of a common screw-driver. The slope towards the cutting edge prepared by delivering a special kind of punching below repeatedly is known as the 'graver facet' and if effected by the removal of one flake it is called a 'single spalled' graver facet. Similarly, we can describe the features of the graver on the basis of spalls, angle of the facet or the position of the spall in relation to the axis of the tool. The classification of gravers is a matter of some controversy, they can be classified according to type or they can be classified according to the method of their manufacture. Here the classification of graver is based on types rather than by method of manufacture. They are (a) Ordinary gravers (b) Angle gravers (c) Single blow gravers (d) Polyhedric gravers (e) Gouge angle gravers (f) Gouge single gravers (g) Beaked gravers (h) Flat gravers (i) Screwdriver core gravers and gouge core gravers.[1]

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1. Burkitt, M.C., The Old Stone Age, 1956, pp.63-64.

DENTICULATES

In the past two decades archaeologists felt that no matter what the general structural features of a flake or blade were, in many of them the entire length of the cutting border was deliberately made serated like a saw. This as much, was thought to be made for some specialized kind of function, which needed to be categorised as a different typology. Thus any tool with evidence of seration is termed a "denticulate."

KNIVES

In the Palaeolithic industries elongated flakes or blades with evidence of deliberate working and with a natural sharp border left untouched have been called as knives or knife blades. In some specialized varieties this retouching occurs in the form of backing or blunting of a border and these are called 'backed knives'. The fashion of this blunting has been found to vary in different industries at different times. Audi knife and chatelperron knife are two of such varieties.[1]

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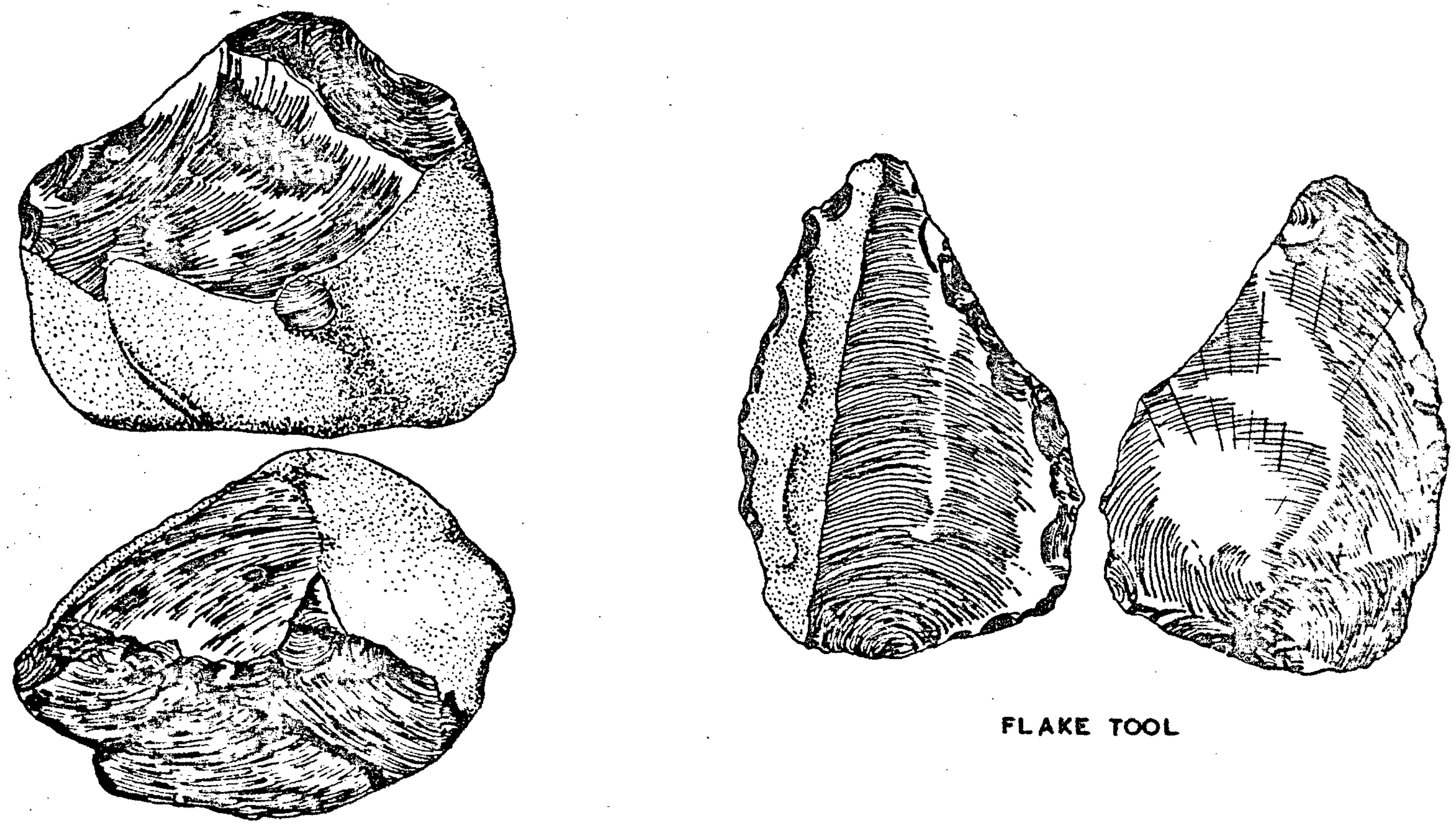
1. Bhattacharya, D.K., Pre-Historic Archaeology, 1972, pp.39-40.

TECHNIQUES OF MANUFACTURE

By far the largest number of prehistoric objects called usually artifacts- because they were made artificially by man and not by nature-consists of stone tools and implements. For this various processes, "techniques" must have been employed in fashioning them into desired shapes and sizes. The earliest tools so far known consist of pebbles with flakes of the same material hammered off from them from one side alone. This chopping of parts from the parent stone material is known as flaking. The small part knocked off is called flake, while the starting material, a lump or pebble of flint or any other hard, fine-grained rock, is called core.(Fig. The surface which remains untouched by the tool maker is called original surface. In cases of pebble tools the original surface is smooth and round, while in cases of naturally broken nodules the original surface is rough and weather-worn as compared to the flaked surface which is comparatively fresher in colour and texture. Original surface in such naturally broken nodules is often referred to as cortex. It is very difficult to identify the cortex in case of badly preserved (weathered) tools. By observations and experiments archaeologist have classified a number of techniques used by prehistoric man in the fashoning of his



CORE TOOL

FLAKE TOOL

FIG.16

stone tools. The various techniques of manufacture used in the Palaeolithic period are as follows:

<u>Block-On-Anvil Technique</u>

In this technique the pebble or block of stone to be worked into a tool was struck against the projecting point of a large fixed block of stone or anvil.[1] The flakes removed by this method are large and massive with a strong elevated portion at the point where the anvil hit the pebble. This elevated bulbar region is known as 'bulb of percussion'. Since it could be difficult to hit the large pebble held in one hand by another pebble held in the other hand employed as a hammer, the block-on-anvil method was most convenient for making comparatively large tools. The scars left on the pebble as a result of this kind of flaking are deep, vertical to the striking plane and are of greater length than breath. Finer retouchings are virtually impossible on the implements made solely by this method.

<u>Direct Percussion or Stone Hammer Technique</u>

This was the most common method adopted by the prehistoric man for making his tools. For this a suitable stone held in one hand acted as a hammer to knock the flakes

1. Leakey, L.S.B., <u>Adam's Ancestors</u>, London, 1953, pp.40-41.

off the stone held in the other hand and trimmed the latter into an implement. The angle and the force with which the hammer was driven would determine the shape and nature of the flake. As a rule the flake carried the elevated bulbar surface while the core recorded a corresponding depression called the negative bulb of percussion. It is important to note that the hammer would usually strike against the border of the tool in making and the chips or flakes would as a rule come off from the lower surface and not from the surface on which the blow was applied. Thus alternate blows given on both the surfaces resulted in the so called bifacial working. The technique is also often referred to as 'alternate flaking technique'.

Step or Resolved Flaking

As the name signifies, while trying to flake a pebble or a block of stone with another, the maker had to control the force of his stroke depending on the kind of tool he had in his mind. This was achieved presumably by driving his force directly towards the centre or the thickest part of the nodule. This restricted the force from travelling over the entire thickness of the nodule and as such got spent off after travelling half way through. The resultant effect manifested in the form of a crack up to the distance the force entered. Thus this technique performed almost a surface chiselling function. This technique is termed step-flaking because of a step like structure observed at the place of the crack.

Cylinder Hammer and Hollow Hammer Technique

Tools were discovered which showed an unusually shallow and elongated flake surface on them. Leakey after experimenting with many kinds of hammers, declared that such flakings could only be effected by using a hollow bone or wooden hammer. It is obvious that such tools reveal a greater technical development and a sense of planning and design not evidenced in the other percussion techniques.[1] The cylinder hammer technique was used for the finishing process.

The writer described in the foregoing the basic techniques used in the detachment of flakes. However there are some techniques described on the basis of the special types of flakes produced. These are clactonian technique and Levalloisean technique.

Clactonian Technique

In this technique a nodule is selected which has

1. Bhattacharya, D.K., Pre-Historic Archaeology, 1972, pp.25-27.

fairly regular surfaces intersecting or meeting in a ridge. such a ridge is normally found in a flat river pebble. It is usually dull and may be rounded, but in the case of a pebble or nodule broken naturally, there might be a sharp edge.[1] These are tools either made of large, massive flakes or are just suitable flakes used as tools. In this technique starting with a nodule with fairly regular surfaces, a sizeable flake was detached by hammering vigorously one of its surfaces with another stone. The detached flake is observed to have a tiny, circular, raised projection on the undersurface. This raised projection is termed as positive bulb of percussion, and the flat surface that had been worked upon is called the striking platform. The flakes removed by this technique, whether with direct hammer or with block-on-anvil method are noted to have the following characteristics:

(1) The flakes are large and massive and as a rule bear prominent bulb of percussion with ripple of force marked occasionally.

(2) The striking platform usually forms an angle of 100°- 120° with the axis of the flake scar.

(3) The striking platform, as a rule, is unflaked and hence composed only of the original surface.

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1. Sankalia, H.D., Stone Age Tools, 1964, p.21.

Levalloisian Technique

The Palaeolithic man adopted a more advanced and skilful method of preparing flakes known as the Levalloisian technique. The name of this technique is linked with the site of an industry in France. The Levallois flakes are a peculiar type of flakes struck from a prepared core. Beginning with the rough trimming of the sides of the core, the technique involved knocking off upper surface flakes in such a way that flake scars were usually left in the centre and the surface of the core was well dressed in a rounded form. By subsequent horizontal flaking at the top of the dressed area, a flattish surface called the 'faceted striking platform' was formed. Finally by hammering the striking platform vertically down the length of the dressed region of the core, tiny and long flakes of required form were detached. The angle formed by the striking platform and the axis of the flake scar is usually observed to be less than or equal to 90°. The cores dressed for the detachment of Levalloisian flakes are called 'tortoise cores' because of their vague similarity with the shape of a tortoise shell. The main features of this technique may be enumerated as follows:

(i) As a rule these flakes are thin and small and their undersurface is composed of a single flat scar.

(ii) The faceted butt bears evidence of its having been deliberately prepared by hammering more than once.

(iii) The positive bulb of percussion is small and flat, as the blow for detachment is not great.

(iv) The scars on the other surface of the flake are all truncated, that is, in none can be seen their points of impact.[1]

Apart from the techniques of manufacture described so far, the prehistoric man adopted another method of flaking which led to the production of uniformly thin, elongated and parallel-sided flakes commonly known as blades. This was well as the techniques used for subsequent retouch are comparatively recent and are not found in the Lower and Middle Palaeolithic Cultures. Some of these advanced techniques are briefly described below.

Pressure Flaking

Pressure flaking, as its name implies, consists of the removal of small flakes by the application of pressure at a given point on a flint edge with a suitable implement made of stone or bone. Usually only fairly small thin flakes of

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1. Bhattacharya, D.K., Pre-historic Archaeology, 1972, pp.27-29.

flint can be removed, for the pressure that can be applied is seldom sufficient to remove thick flakes. A characteristic appearance of the resulting flake surface is frequently such as to give rise to the term 'fish scale' flaking.[1] The main feature distinguishing the pressure flaking from the percussion technique is that the hammer in this case remained in direct contact, pressed hard with the stone block till a narrow parallel-sided blade would jump off. Thus the constant force for a length of time was involved in this case in contrast to the swings of the hammer in the percussion technique. This technique was specialized by the Upper Palaeolithic man for producing blades.

Fluting Technique

This technique was used for making blade tools. Under this technique, starting with suitably prepared cylindrical nodes, a series of uniformly thin , parallel-sided blades were detached in rapid succession by applying vertical pressure on the edges. The blades could be flat as well as crested. The blades produced by fluting were, however, crested with multiple flake scars transversely across the crest. It was pointed by Sir John Evans that these

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1. Burkitt, M.C., The Old Stone Age, 1956, p.51.

scars were taken out from the surface of a natural nodule in order to form a corner along the length of the otherwise spherical surface of the material. Thus a blow delivered on the top of this ridge or corner would detach a blade with the marks of the transverse flakings retained on it. It has been argued that besides forming a hold for the application of vertical pressure these transverse flaking were also meant to guide the length of these blades, so that on application of the vertical pressure a blade of only that length would be produced up to which the crest had been prepared. Therefore, such blades have been called crest-guiding blade.[1]

Backing or Blunting

Blades manufactured by fluting technique were further retouched to form specific tools. Since every blade had two readymade sharp edges, retouchings in these blades were mainly done by blunting any specific area out of the two already present borders. The area chosen and the manner of blunting depended on the requirement of the maker. These bluntings were done mainly to afford a firm hafting of blades on handles. A sharp edge in the groove of handle always had

1. Bhattacharya, D.K., Pre-Historic Archaeology, 1972, p.30.

the risk of cutting in and getting imbedded in the handle when force was applied to cut anything with the other sharp edge of the blade. Thus, it is significant to note that while secondary workings in core and flake tools were mainly aimed to impart sharpness, in blades tools they were done to blunt an already sharp edge.

Grinding and Polishing Technique

The last phase of the Stone Age in man's past is marked by various sophisticated flaking techniques developed by him for making stone tools carefully shaped and thinned by the removal of a mass of flakes from the surface of a flint, obsidian or any other rock. Subsequently, the uneven surfaces formed around the intersection of the flake scars were removed by a pointed sharp edge. This process of working is called pecking. Finally the tool used to be ground by rubbing against a boulder, which imparted it an overall smothness. As this was a very long process, in many cases only the working edge was ground.[1]

To sum up, in the various techniques described above, a basic difference is observable. In the Clactonian, Levalloisian and Mousterian methods of producing flakes it is

1. Bhattacharya, D.K., Pre-historic Archaeology, 1972, p.31.

pointed out that

(i) the cores were usually flat;

(ii) the platforms wide and faceted;

(iii) the flakes round, oval or triangular.

But as opposed to this in blade techniques:

(i) the cores are generally cylindrical and "fluted";

(ii) the flakes long, narrow, and slender;

(iii) the platforms of the flakes show minute facets.

RAWMATERIAL FOR THE TOOLS

The Stone Age tools bear an intimate relationship with the rawmaterial, that is various geological formations. This is particularely so during the early Stone Age, when the tools were comparatively large and so man could not import the pebble or rock, but had to rely upon the local material.

This is well demonstrated by the distribution of the various rock formations in India and the nature of the raw material of tools. Thus we find that majority of Early Stone Age tools found in all parts of the subcontinent are made of quartzite, one of the oldest rocks, wherever it was available. But in the Deccan Plateau or Maharashtra, this formation is covered by the masses of lava called basalt or trap. So man was forced to use the latter material. But even here he chose the fine-grained material from dolerite, which occurs as intrusive dykes in the basalt. As we leave the basalt plateau, quartzite reappears, occasionally with other material such as quartz, fine sandstone, jasper and even the intractable gneiss. The best instance of such a varied material is in North Karnataka, where in the beds of the Malaprabha the classic site of Khyad yields tools in all these rocks. Similarly it is widespread in central India, where we have quartzite, sandstone etc.(Fig.17).

The same intimate relationship with rawmaterial one beholds in the Middle Stone Age, though the tools were smaller, and man could have if he wished, transported to short distances, the material he liked. But he never did so. Fortunately, his needs were such that he worked very fine-grained material such as flint, and in the absence of this varieties of chalcedony- like agate, jasper and chert. These he found as veins and as out-crops in several parts of India, where as in the lime-stone regions in Andhra, Karnataka, Rajasthan, Madhya Pradesh and in Sind, he got flint or flint-like material. Flint is confined to certain regions only, but the chalcedonic material was more easily available,

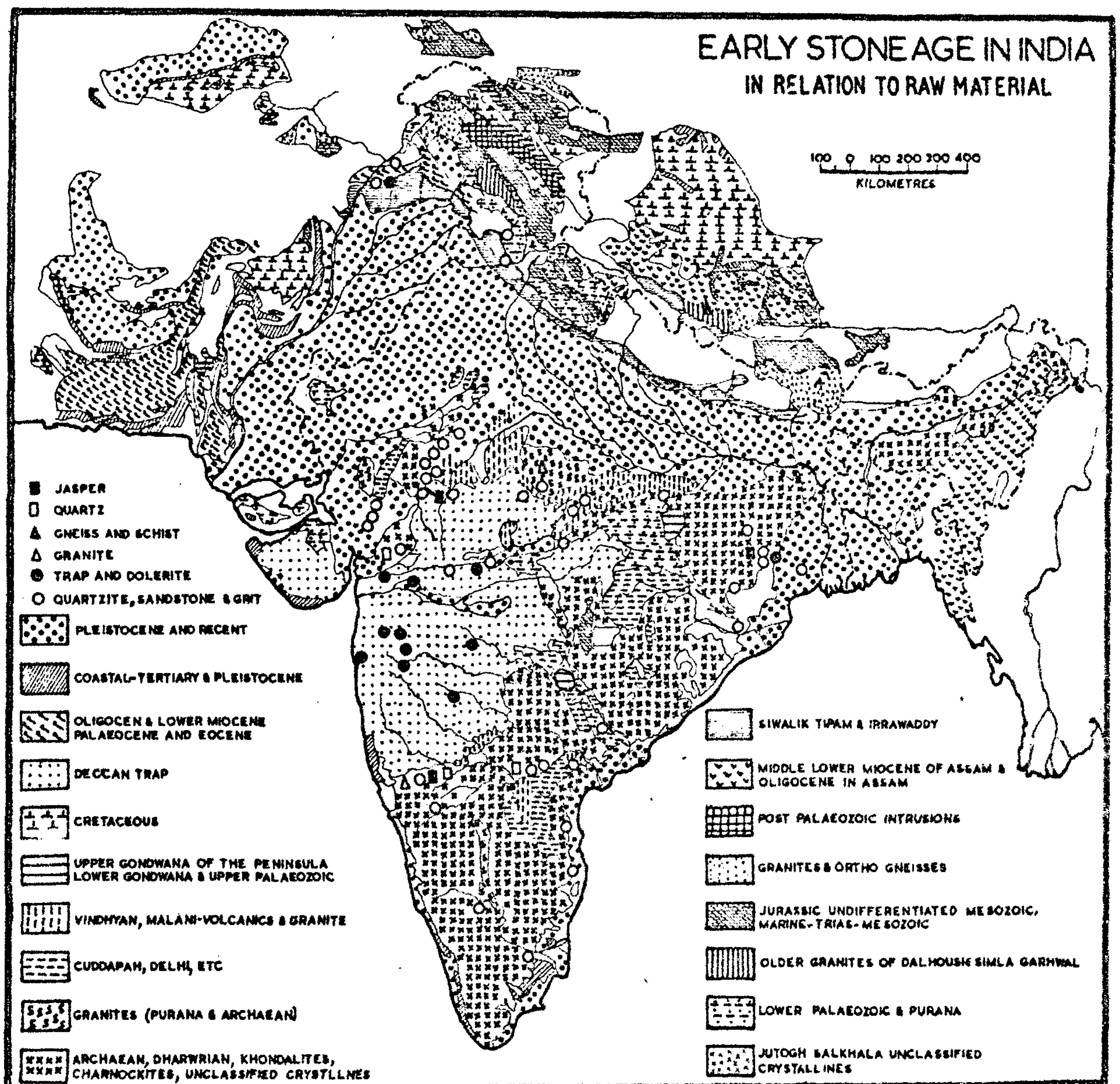
EARLY STONEAGE IN INDIA
IN RELATION TO RAW MATERIAL
100 0 100 200 300 400
KILOMETRES
JASPER
QUARTZ
GNEISS AND SCHIST
GRANITE
TRAP AND DOLERITE
QUARTZITE, SANDSTONE & GRIT
PLEISTOCENE AND RECENT
COASTAL-TERTIARY & PLEISTOCENE
OLIGOCENE & LOWER MIOCENE PALAEOCENE AND EOCENE
DECCAN TRAP
CRETACEOUS
UPPER GONDWANA OF THE PENINSULA LOWER GONDWANA & UPPER PALAEOZOIC
VINDHYAN, MALANI-VOLCANICS & GRANITE
CUDDAPAH, DELHI, ETC
GRANITES (PURANA & ARCHAEAN)
ARCHAEAN, DHARWRIAN, KHONDALITES, CHARNOCKITES, UNCLASSIFIED CRYSTLLNES
SIWALIK TIPAM & IRRAWADDY
MIDDLE LOWER MIOCENE OF ASSAM & OLIGOCENE IN ASSAM
POST PALAEOZOIC INTRUSIONS
GRANITES & ORTHO GNEISSES
JURASSIC UNDIFFERENTIATED MESOZOIC, MARINE-TRIAS-MESOZOIC
OLDER GRANITES OF DALHOUSIE SIMLA GARHWAL
LOWER PALAEOZOIC & PURANA
JUTOGH SALKHALA UNCLASSIFIED CRYSTALLINES
AFTER SANKALIA

FIG.17

specially in the basalt area, than quartzite and dolerite. Hence the tools are found widespread in the river beds and along the foothills.[1] Most frequently the material appears to have been obtained in the form of river pebbles. These would drive from nodules of silica formed in the volcanic trap rocks which are found in so much of central India and the more northerly parts of the peninsula.[2]

The total dependence upon the rawmaterial seems to become less during the Late Stone Age when man did import the material he wanted from a distance. Thus in the sandy, alluvial plains of N.Gujarat, not a piece of stone can be had. Here man had to get chert, agate, quartz, microline etc. at least from a distance of thirty miles for making microliths with which the whole region is strewn. The river bed contains only large and small pebbles of quartzite. Again in the extreme south in the teris, man got quartz etc; where as locally only fossil wood, chert and the like are available.

In considering the rocks which man had at his disposal for his needs we may look at the deciding factor, besides availability, in the choice of material. The important

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1. Sankalia, H.D., Stone Age Tools, Their Techniques, Names and Probable Functions, 1964, p.104
2. Allchin, R. and Bridget, The Birth of Indian Civilization, 1968, p.67.

rocks suitable for the majority of tools belong to one mineral group, the quartz group of rocks.[1] These rocks have a few qualities in common. Of these the important one is the extreme hardness. An essential quality of many varieties of quartz, which determines its choice by man, was isotropism (glassy nature). Minerals and rocks used by Stone Age man for tool making purposes were: rock crystal (quartz group), obsedian (volcani glass), chalcedony (used only where no other rock was available), agate (quartz group), flint (quartz group, exceptionally wide use during the stone age), jasper (quartz group), chert, quartzite (silicified sand stone, in general use in countries where flint was scare), diorite and basalt. This is not an exhaustive list. That would have to include granite, sandstone and ironstone but taken as a whole they were not basic but auxiliary material in the technology of prehistoric man. As a general rule man did not use stones which did not possess great hardness and which could not be quickly worked by the early methods of percussion and pressure flaking.

In actual practice the material was selected on the basis of practical experience, where flint was available it was chosen in preference to other rocks because of its physical

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1. Semenov, S.A., Pre-historic Technology, 1973, p.33.

properties. In region where no flint was available, as in S.Asia, the Stone Age man was compelled to use predominantly pebbles of chert, jasper, quartz and rhyolite, all products of erosion and weathering of ancient sedimentary and metamorphic rocks. Such material could not yield fine cores or blades.

The dependence of the stone tools on the properties of the rawmaterial shows the importance of the source of these material in the economic life and technology of the society.

FUNCTION

The functional aspect of stone age tools has been divided into six categories:

(1) for scrapping or shaving skin and wood,
(2) for piercing skin and hides,
(3) for cutting and ripping meat and skin,
(4) for groving and engraving bones and stone,
(5) for projectile heads or borers and
(6) for use as multipurpose tools.

Both cleaver and handaxes must have been multipurpose tools. It has been shown that they are particularly effective as skinning knives and meat choppers. Axes also could have been used as digging implements and would serve as well to despatch trapped animals as to cut off branches. One of the principal function of both handaxes and cleavers must have been as meat mattocks.[1] It has also been suggested that the preponderance of cleavers over handaxes in any collection indicates a more wooded environment and the use of heavy wood.[2] There is definite evidence that some cleaver types and handaxes from peninsular India were hafted.

Less certain as a multipurpose tool is the Levalloise flake. Such tools were probably employed in much the same way as thin handaxes, as knives and scrappers.

Tools for cutting and ripping include axes, cleavers and levalloise flakes but specialized forms occur later. For instance the meat knife for cutting fibers and tendons, was often made on a long blade. Some shouldered points have been shown to be cutting and ripping knives. Some may have been used as projectile heads. Beaked blades are another form generally considered to be knives, for more delicate cutting.

Scraping tools were also necessary in the preparation of skins and hides. There are several major forms of

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1. Clarke, G., Pre-History of Africa, 1970, p.99.
2. Zeuner, F.E., Environment of Early Man with Special Reference to Tropical Regions, 1953.

scrapers and functional studies have shown the manner in which they were used. The side scraper is a tool characterized by a convex sharp edge. The convex surface was essential so that the edges of the tool will not cut the skin. End scrapers are self descriptive. They occur mainly on blades and retouch is confined only to the end where a sharply convex cutting edge is formed.

Microliths are generally considered to be the heads or barbs of arrows. In some cases they have been discovered with their adhesive fastening.

CHAPTER III

PERIODIZATION OF INDIAN LITHIC CULTURES

Our concern here is with the inception, development and growth of man's lithic cultures in India during Middle and Upper Pleistocene. For that long period of man's history, that is all pre-history we have no written description of culture. We find only the tools man made and the places where he lived. Fortunately for us these tools and living places give us a lot of information about the Pleistocene humanity.

Archaeologists have reached some measure of agreement on a tentative and provisional chronology to establish cultural sequence during pre-history. It is customary to divide man's cultural record into three ages: Stone Age, Bronze Age and Iron Age. The Stone Age, because of its unweildy size, was later subdivided into Old Stone Age (Palaeolithic) and New Stone Age (Neolithic). The Palaeolithic is usually chronologically equated with the Pleistocene. It is also conceived of as an economic and technological stage in man's cultural development. It was a time when man lived exclusively by hunting, fishing and collecting and made his tools by chipping but never by grinding and polishing.[1]

The Old Stone Age or the Palaeolithic is further classified into Lower, Middle and Upper on the basis of two different methods of classification existing side by side: 'into a purely chronological stage' (valid for the entire area as stratigraphic chronological units) and cultural phases (starting and ending at different times in different areas and completely lacking in some regions). This, however, has resulted in a great deal of confusion as some units that were originally seen chronologically eventually turned out to be definable only from the stand point of cultural phases. It is therefore necessary to effect a clarification, i.e., to distinguish between purely chronological units on one hand and purely cultural ones on the other when studying the Stone Age sequence of any given region.

The Old Stone Age or the Palaeolithic ends with the Pleistocene. The grand over-all dating of the Pleistocene is in terms of its glaciation cycle. Unfortunately there is no agreement among geologists as to the number of Pleistocene glaciations but four glaciations are generally assumed. The Upper Palaeolithic falls into the post-maximum glacial end

1. Burkitt, M.C., The Old Stone Age, 1956, p.24.

of the Pleistocene.[1] The Lower Palaeolithic, though essentially a cultural and not a chronological term, lasted in most parts of the world from the beginning of the Pleistocene to the end of the third glaciation, a period of some half a million years.

The great French archaeologist De Mortillet further classified the Palaeolithic into six stages as follows:

Upper Palaeolithic	Magdalenian Solutrian Aurignacian
Middle Palaeolithic	Mousterian
Lower Palaeolithic	Acheulian Chellean or Abbevillian

Though De Mortillet's 'classic' or conventional series has been rightly abandoned as provincial and inapplicable outside Western Europe it still has the usefulness of providing a convenient frame of reference for studying Old Stone Age sequences elsewhere in the world. As a matter of fact most of the original terms developed by De Mortillet for his "classificatory system" are still in use and they

1. Kroeber, A.L., Anthropology, 1948, p.648.

are now employed in several different sequences- chronologic, typologic, technologic and cultural.

Periodization of Indian Lithic Cultures

The first serious attempt at systematization and periodization of the prehistoric cultures of India based on internal evidences, was made by Bruce Foote of the Geological Survey of India in 1916.[1] He recognized four stages in prehistoric Indian cultures:

I. The Palaeolithic, or rude stone age
II. The Neolithic, or polished stone age
III. The Early Iron Age
IV. The Later Iron Age

Later, as a result of continued discoveries, a need was felt for further systematization, particularly for the Palaeolithic age. As an answer to this need a scheme was put forward by Burkitt and Cammiade in 1930 which divided the Palaeolithic into four major groups, called series I, II, III, and IV and it was suggested that these correspond in general to Lower, Middle, Upper Palaeolithic and Mesolithic cultural groupings recognized in Europe.[2]

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1. Foote, R.B., The Foote Collection of Prehistoric and Proto-historic Antiquities, 1916.
2. Burkitt, M.C. and Cammiade, L.A., "Fresh Light on the Stone Age of Southeast India", Antiquity, 1930, pp.327-29.

In the post- independence period it became more and more apparent that in the light of the growing body of material in all branches of Indian prehistory the four fold classification of Burkitt and Cammiade could not serve as an ideal framework for the study of the Indian Stone Age cultures. The position was this: de Terra and Paterson's work of 1935 confirmed the presence of two cycles of Pleistocene aggradation in India. Whereever handaxe industries, resembling closely their counterparts of Lower Palaeolithic Europe, Western Asia and Southern Africa occurred in recognizable deposits, they were associated with the earlier of the two aggradation pheses, both of which, as we have seen in the first chapter, could be assigned to the second half of the Pleistocene. A second group of industries called the microlithic, had also been recognized. They always occur in recent geological context. The fourfold classification assumed that the handaxe complex and microliths belonged to the two aggradation cycle but since the industries which occupy the stratigraphic position between the former and the latter are ill-defined and in the present state of our knowledge cannot be regarded as definitely belonging to a blade and burin industry equivalent to those of Upper Palaeolithic of Europe, the terms Lower, Middle and Upper Palaeolithic in Indian context, lead to a lot of confusion.

Therefore it is suggested that a three fold subdivision - Early, Middle and Late Stone Age, would be more appropriate/ (Fig.18). This also corresponds to the terminology used in Southern Africa.[1]

The broad sub-divisions like Early, Middle and Late Stone Age have been adopted in this work in preference to the Lower, Middle and Upper Palaeolithic. Since the latter three terms, as pointed out by Garrod, "should be used exclusively in a chronological sense"[2] their use in Indian prehistory at the present state of our knowledge, would be purely immature, being unwarrented by relevant evidences.[3]

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1. Goodwin, A.J.H. and Lowe, C. VanPeit., "The Stone Age cultures of Southern Africa". Ann. S.Africa Mus.Vol.27. 1929.
2. Garrod, D.A.E., "Upper Palaeolithic in the Light of Recent Discovery", Proc. Prehist.Soc. N.S. Vol.IV, 1938, p.2.
3. There are three major objections for their use:
   (i) Inadequate geological and palaeontological data; so lack of a clear chronology of the Pleistocene.
   (ii) The so called Middle Palaeolithic cultures of India have very little typo-technological similarity with the similar cultures of Europe and Africa.
   (iii) At present there is no clear evidence of a culture which can strictly be called the "Upper Palaeolithic India". No doubt a few blades and a burins have been tentatively attributed to this culture but their typological and stratigraphic position is not at all free from serious doubts and controversies. Moreover their distribution is also not as wide is expected to designate them as representing a separate culture.
   Over looking these three points many Indian prehistorians have used these European terminologies which not only has obscured the real character of Indian lithic industries but also has led us into rash correlations and irrelevant conclusions.

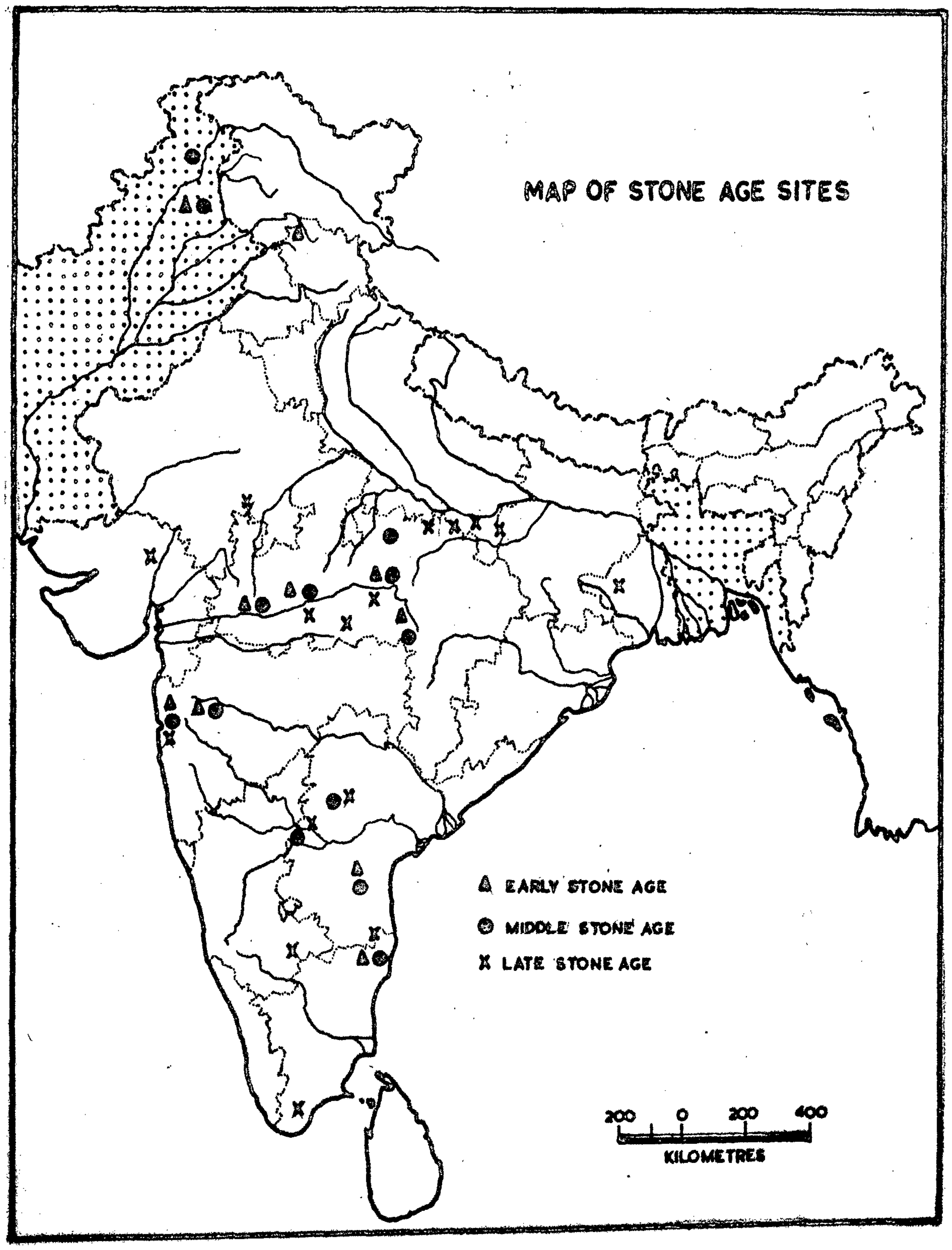
MAP OF STONE AGE SITES
EARLY STONE AGE
MIDDLE STONE AGE
LATE STONE AGE
200 0 200 400
KILOMETRES

FIG.18

The handaxe- cleaver and pebble chopper- chopping tool traditions of India undoubtedly started during the Middle Pleistocene. Throughout the length and breath of India they occur more or less in a strikingly similar stratigraphic contexts like, the coarse gravel and the secondary laterite. It comes to an abrupt end by the introduction of the flake tools of smaller dimentions. Inspite of the fact that these flake tools to some extent have developed from the Early Stone Age industries, they represent a distinct cultural trend in technique, typology, stratigraphy and raw material. A large number of pigmy tools seems to have succeeded the flake tools. They also present us with a different typology, technique and stratigraphy.

The terms Early, Middle and Late Stone Age[1] have been used to designate these three distinct traditions of tools. The handaxe-cleaver and chopper-chopping tool traditions of India, representing the beginning of its stone cultures, belong to the Early Stone Age. Most probably it co-terminates with the Middle Pleistocene after obtaining its final development. The smaller flake-tools, stratigraphically succeeding the Early Stone Age industries, are designated

1. These terms were also endorsed by a committee appointed to review the terminology of the Indian Stone Age at the International Congress of Asian Archaeology in New Delhi in December 1961.

as the Middle Stone Age tools. They start from the end of the Early Stone Age i.e., probably from the Middle Pleistocene and co-terminate with the Upper Pleistocene. The pigmy tools are included in the Late Stone Age.[1]

General Characteristics of Indian Palaeolithic Cultures.

The Indian Early Stone Age covers the conventional Lower Palaeolithic types and includes, in the Indian context, the main peninsular chelles-Acheul complex of handaxes and cleavers and the extra peninsular Soanian and Banganga assemblages, while the Middle covers the widely distributed group of industries consisting of scrapers and blade-flakes, from Nevasa and Mehashwar, Waingana etc. At present they cover the industries being described as series II. Where as Late Stone Age covers the range of microlithic industries such as those of the Teris, Singrauli, Birhanpur, Langhnaj etc/ (Fig.19).

The majority of Early Stone Age tools found in all parts of the sub-continent are made of quartzite. Some times quartzite pebbles were used, particularly for making the earlier and cruder handaxes, and for making chopping tools at all periods. The other source of quartzite was outcrops

1. Late Stone Age includes all stone age industries of Holocene like (1) nongeometric microlithics, (2) geometric microlithics and (3) polished stone celts.

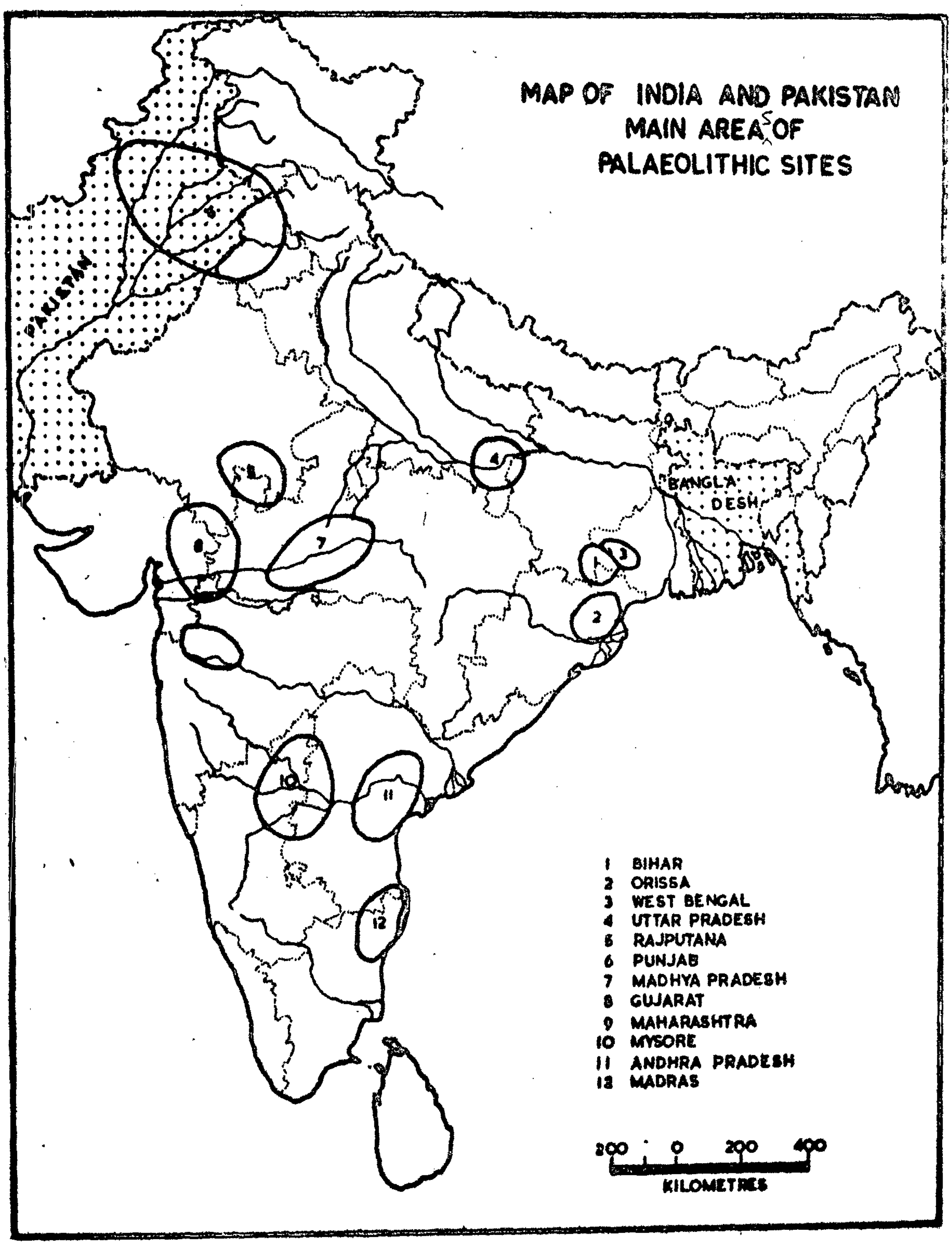
MAP OF INDIA AND PAKISTAN
MAIN AREAS OF
PALAEOLITHIC SITES
PAKISTAN
BANGLA DESH
1 BIHAR
2 ORISSA
3 WEST BENGAL
4 UTTAR PRADESH
5 RAJPUTANA
6 PUNJAB
7 MADHYA PRADESH
8 GUJARAT
9 MAHARASHTRA
10 MYSORE
11 ANDHRA PRADESH
12 MADRAS
200 0 200 400
KILOMETRES

FIG 19

of rock and boulders.[1]

Large quartzite flakes lend themselves to the production of cleavers more readily than pebbles or nodules of rock, and it seems probable therefore that the increasing numbers of cleavers in later phases of Early Stone Age may be related to a change in the source of supply. Other core tools, more or less ellipitical or circular in outline, may be with the same flaking techniques as the handaxes and cleavers, are found in almost every Early Stone Age assemblage. These generally show signs of use around the edge, but this is often concentrated in one or two areas. There is little doubt therefore that these tools were used for chopping and cutting, and also perhaps for digging and scraping hides.[2] Early Stone Age in India records such refined and advanced handaxes and cleavers along with retouched flakes that individually speaking they can compare with the best of European African Lower Palaeoliths.[3]

The material from which the Middle Stone Age tools were made are chiefly crypto-crystalline silica of various kinds such as agate and jasper, or chalcedony, which have a smother and more regular concoidal fracture than the some what

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1. Allchin, R. and Bridget., The Birth of Indian Civilization, 1968, p.62.
2. Allchin, R.& Bridget, ibid., p.64.
3. Bhattacharya,D.K., Pre-Historic Archaeology, 1972, p.122.

granular quartzite favoured in Early Stone Age times. Most frequently the material appear to have been obtained in the form of river pebbles.[1]

Pointed flakes, generally more or less leaf-shaped, and sometimes with fairly steep retouch or regular use marks along one or both edges, occur fairly commonly in collections from many parts of India. Large borers, worked with steep retouch on thick flakes are also characteristic of the earlier Middle Stone Age in central and peninsular India in particular. Frequently they form parts of a composite tool consisting of a 'beak' or borer point and two hollow scrapers. Burins are rare and of a simple undifferentiated kind at this stage, although in certain of the later Middle Stone Age industries they are rather more common. There is a wide variety of scrapers. Concave convex or straight scraper edges have worked, generally with steep retouch, on round square or pointed flakes, either with or without prepared striking platforms. Scrapers are sometimes also found worked on the long edges of blade flakes. We also see the cores and flakes of triangular outline and parallel-sided blade-flakes are more numerous. The bulbs of percussion with fairly robust hammer.[2]

1. Allchin, R. & Bridget.,op.cit., p.67.
2. Allchin, R. & Bridget., ibid., 1968, p.73.

As pointed out earlier, the Middle Stone Age in India forms the second cultural phase of the Pleistocene. The industries of this period are usually found from the deposits of the second phase of aggradation. The tools of this culture, in most of the cases are made on fine grained silicious rocks with glassy appearance. The tools found in this culture are usually thinner and made on core as well as flakes. As far as the typo-technological character of this age is concerned, no remarkable change seems to occur from preceding culture. It would seem that as a matter of convenience for working with small sized lumps of raw material, the hammer in this culture is chosen to be pointed and made of wood or a small pebble. The bulbs of percussion as such are more pronounced in many flakes. Except these characteristics, the basic flaking and retouching techniques continue from the earlier culture with out any significant development.[1] It will appear from the foregoing that the Middle Stone Age in India has a number of distinctive characteristics, they are as follows;

(i) The first striking characteristic of the Middle Stone Age is that it seems to be conspicuously absent from northern India. Here it may be recalled that Bridget Allchin

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1. Bhattacharya, D.K., Pre-Historic Archaeology, 1972, pp.124-125.

had suggested that Late Soan of Punjab should be included in the Middle Stone Age on the basis of its stratigraphic similarity with the Nevasian and also because of the overriding predominance of flake industries in this culture. However, since the typologies of the Late Soan cannot, in any sense, be compared with the Nevasian, such as suggestion remains only of academic significance.

(ii) The second significant feature of the Middle Stone Age is the sudden disappearance of the rawmaterial used in the preceding age.

(iii) Finally the lack of heavier tools, with only occassional exceptions, also appear to be an important feature of this age.

After the Middle Stone Age comes the Late Stone Age culture-the tools of this culture are made on both silicious rocks like quartz, chert, chalcedony and also on quartzite and fossil wood. The predominant and most characteristic typologies found from the Teri sites are: blade flakes, blades, back-blades obliquely blunted blades, scrapers of all varieties on flakes, discoids, simple unretouched flake points, unifacially and bifacially worked points, lunate, transverse arrow-heads or broad traperzes, triangles, chopping tools and cores.

Among these tool types the lunates predominate, as is usual with pure Late stone age sites. The bifacial points from Teri represent a unique typology and is not reported from any other Late stone age factory site in India.[1] The rock shelter at Adamgarh Hill in the Narmada Valley, where points and blades predominate, lunates and triangles appear in an appreciable number and trapezoidal forms occur occasionally. The mammalian fauna of both wild and domesticated animals has also been found. The added significance of this site is the determination of the first ever date for a primary Late Stone Age culture in the Indian sub-continent, for the shell finds from this site have been dated nearly 5500 B.C. by carbon dating method. Thus the Late Stone Age in India seems to represent a brief transitional cultural phase in the earliest part of Holocene.

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1. Bhattacharya, D.K., ibid, 1972, pp.129-136.

CHAPTER IV

THE EARLY STONE AGE IN INDIA

The Early Stone Age in India is characterised by several tool complexes and traditions. The spatial and vertical distribution of these is as yet imperfectly known. Broadly three lithic traditions or complexes are recognizable:[1] (i) A biface core- tool tradition broadly similar to the Abbevillian - Acheulian complex of Europe and Africa; (ii) a pebble tool tradition broadly similar to the Kafuan-Oldowan of Africa and (iii) a flake tool tradition coupled with pebble tools, broadly similar to the Anyathian of Burma and Choukoutienen of China. It appears that the three traditions are but integral components of one great cultural complex since elements which appear to be characteristic of one are also observed to occur in the others.

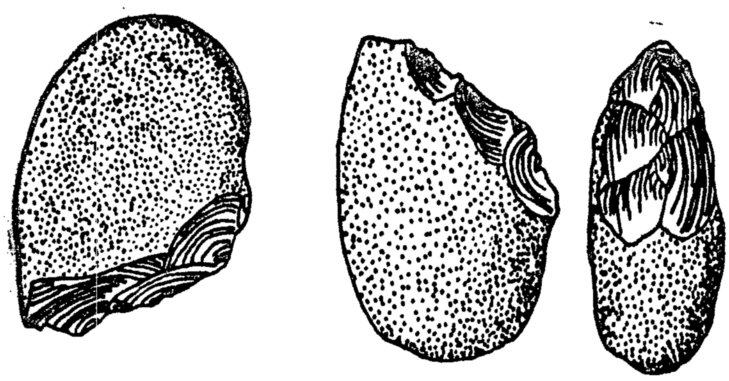
The main centre of the core-biface tradition during the Early Stone Age was on the east coast round Madras. The biface industry which predominantly include the handaxe on core, is characterized by a great variety of forms and several stages of handaxe development are distinguishable. Besides the east coast similar biface and cleaver industries

1. Sen, D., "Lower Palaeolithic Cultural- Complex And Chronology in India", Eastern Anthropologist, Vol.VII, No.2, 1954, pp.61-83.

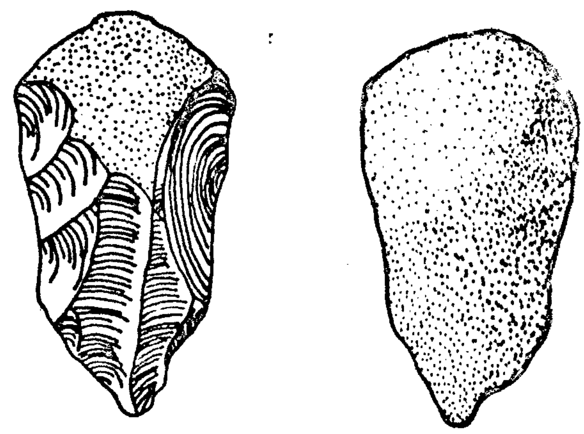
also occur further inland in Tamil Nadu, Karnataka, Andhra Pradesh as well as Bombay on the west coast, northward in the Narmada a valley, in Madhaya Pradesh, the Son-Rihand Valley in Uttar Pradesh, north-eastward in the Manbhum-Singhbum region of Bihar. In the west, besides Bombay, the biface industries are conspicuous by their presence in the Sabarmati- Mahi Valley in Gujarat. The preponderance of the biface, however, diminishes westward and northward and a marked regional difference in the frequency of core and flake elements is observed. In the Punjab the biface occurs as a complex along with the more dominant pebble and flake industries (Soan) but the Soan type of tools predominate. Thus over large parts of the peninsula, the biface and cleaver industries predominate and extend to the northern most border. They apparently disappear beyond edge of the peninsula. They reappear in the northwest as an integral component of the Acheulian- Soan complex. But wide spaces remain yet unexplored.

The pebble-tool tradition is an important element within the Early Stone Age culture- complex of India. In north India and in the Punjab pebble-tools are free of the biface and occur as an integral part of the Soan culture (Fig.20). In peninsular India, as in Madras, Mayurbhanj, Mirzapur and

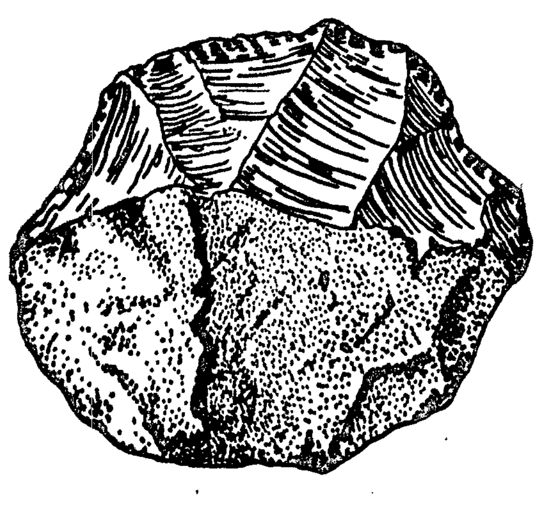
EARLY STONE AGE TOOLS



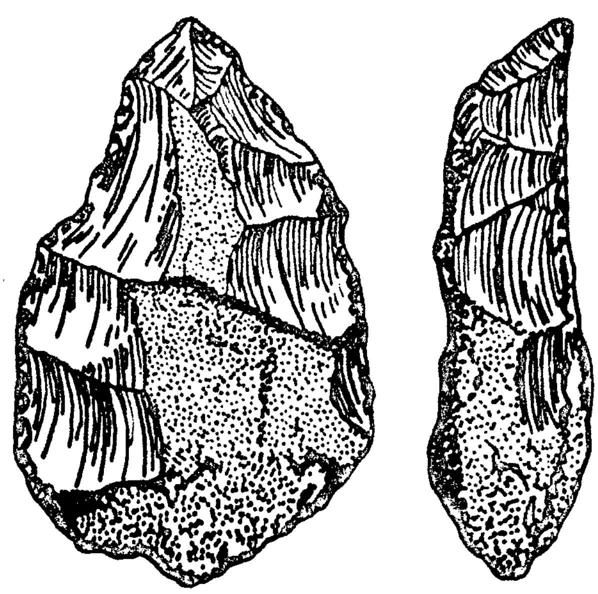
THREE VIEWS OF A PEBBLE TOOL



UNIFACIAL PEBBLE TOOL



CHOPPER



HAND AXE

FIG. 20

elsewhere, pebble tools are generally found associated with the biface.

The Indian flake culture appear to have its main concentration in the Punjab where it is known as the Soan and which is generally free of the biface.

<u>Regional Cultural Complexes during the Early Stone Age</u>
<u>Kashmir</u>

Untill quite recently it was thought that Kashmir was totally uninhabited during much of the Ice Age. De Terra wrote, "considering that the Palaeolithic man invaded the foothills in the Punjab and Poonch as early as Middle Pleistocene, it may seem strange that similar record are lacking from Kashmir proper.[1] Incidently de Terra himself had discovered in 1934 a single patinated flake near Kargil, but believed that it was carried by prehistoric wanderers in sub-recent time. De Terra's main argument that Kashmir was un-inhabited during much of the Pleistocen was that the Pirpanjal at that time must have been quite dangerous for prehistoric man to cross, who probably preferred the lower grasslands to the alpine heights. The recent discovery of true palaeoliths by Sankalia in May 1969 at Pahalgam has,

1. De Terra and Paterson, op.cit., p.234.

however, altered this picture.[1] It should be mentioned here that the presence of man during the second glaciation was also vaguely anticipated by Grinlinton earlier who found a boulder which looked "almost a handaxe".[2]

In later visits Sankalia collected about a dozen more specimens from the Liddar and Sind Valleys, the majority from the former.[3] Sankalia's discoveries initiated renewed interest in the area and in 1972 ten more Early Palaeolithic tools were discovered from the glacio-fluvial deposit at Pahalgam in the Liddar Valley.[4]

The tools were obtained from the Boulder conglomerate and at its junction with the overlying brown silt. In the light of available information on the Quaternary history of the Kashmir Valley, a Mid-Pleistocene age has been assigned to the Boulder beds of Pahalgam and hence also to the Early Palaeolithic tools. It should be pointed out here that tools typologically similar to that of Pahalgam were also stratigraphically dated as belonging to the Mid-Pleistocene

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1. Sankalia, H.D., "Early Man in Ice Age Kashmir", Science Today, Vol.IV, No.6, 1969, pp.16-26.
2. Grinlinton, J.L., "The Former Glaciation of the East Liddar Valley", Mem. G.S.I., Vol.XLIX, Part II, 1929, p.340.
3. Sankalia, H.D., "New Evidence for Early Man in Kashmir", Current Anthropology, Vol.XII, 1971, pp.538-61.
4. Joshi, R.V., S.N.Rajguru, R.S.Pappu and B.P.Bopardikar, "Quaternary Glaciation and Palaeolithic sites in the Liddar Valley", World Archaeology, Vol.V, 1974, pp.369-77.

in the periglacial Potwar Plateau.[1] The occurrence of the tools at the junction of the Boulder beds and the over-lying sand and clay suggests that the climate at that time of occupation of the Liddar Valley was not very severe and that the entire process of the formation of the Boulder beds, alluvial cones, clays and sands was influenced by fluvial action, doubtless intensified by heavy monsoonal precipitation.

The Pahalgam palaeoliths consist of flakes, a handaxe, scrapers, borers and choppers. The unifacial and bifacial types are almost of equal importance and, compared to other areas, the handaxe and cleaver component is meagre in the tools so far discovered.[2] (Fig.21).

The Peri-glacial Punjab Plains

The Potwar Plateau, in the periglacial Punjab plains, has yielded one of the most important lithic-culture complex of Early Stone Age in India. The earliest lithic industry of the region, termed pre-soan, occurs near the top of the Boulder conglomerate zone of the Upper Siwalik formation in the Soan Valley. These tools are crude, massive and highly cortexed. The nature of their occurrence and

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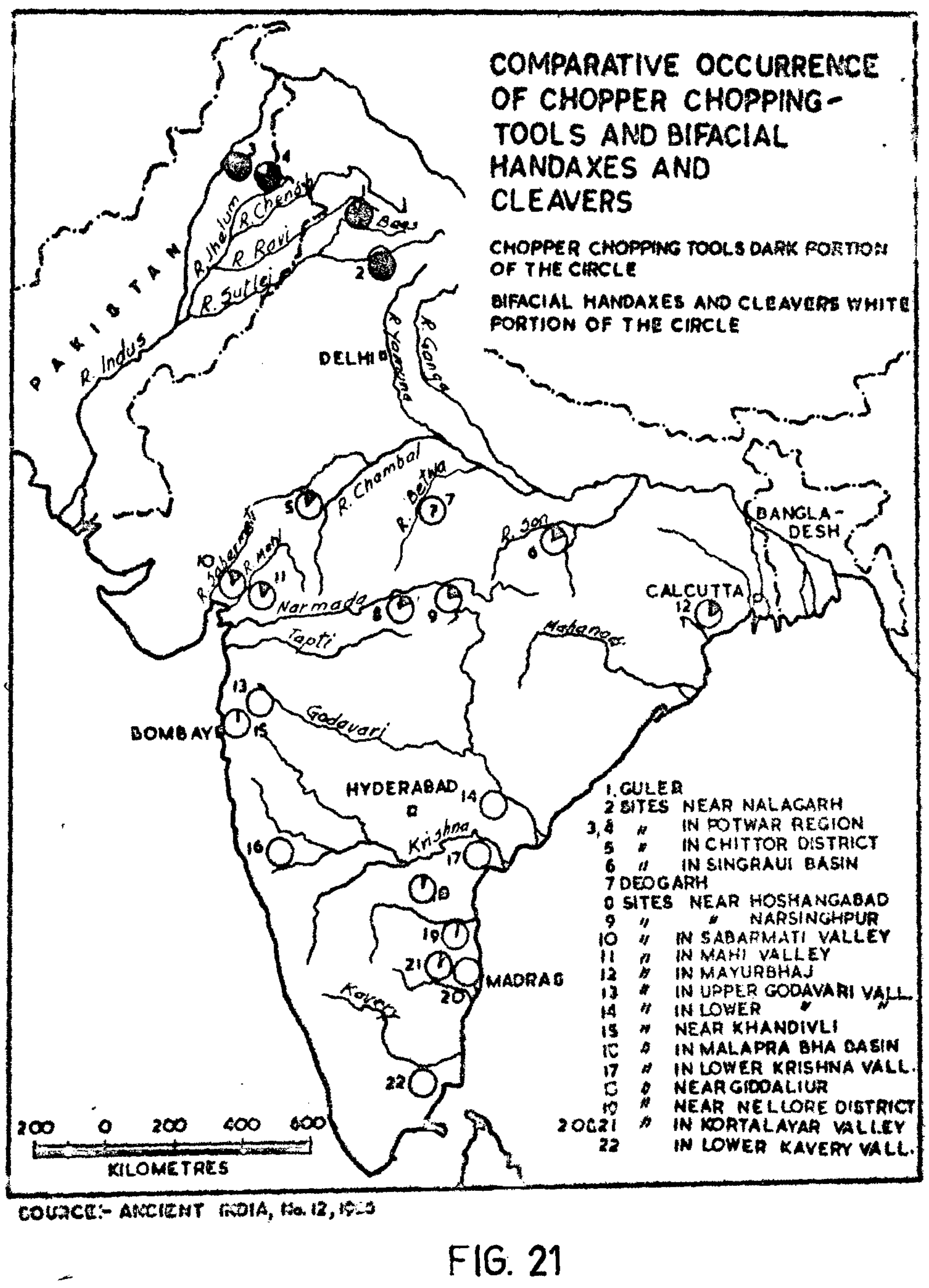
1. Raza, M., "Pleistocene Environment and Palaeo-Anthropology in Kashmir", The Geographer, Vol.XIX, 1972, pp.47-55.
2. Joshi, R.V., op. cit., p.376.
   S.N.Rajguru,
   R.S.Pappu and
   B.P.Bopardikar,



SOURCE:- ANCIENT INDIA, No. 12, 1956

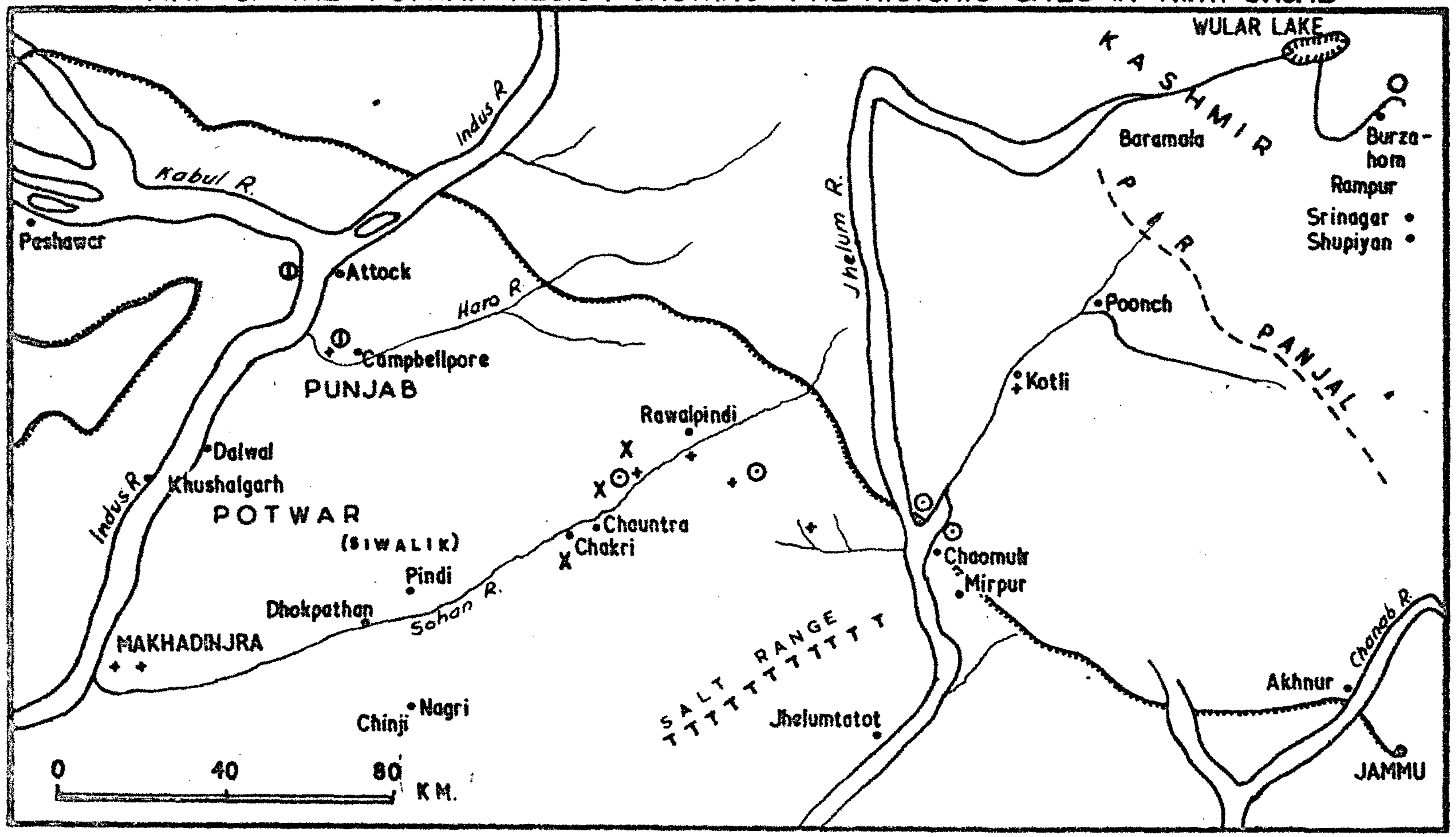
FIG. 21

their relative searcity do not admit of any defined industry.[1] Apparently this type of tool disappeared in the second interglacial. The term pre- Soan is used in a purely chronological sense so as not to suggest and genetic or derivative relationship with the succeeding Soan culture (Fig.22).

The river Soan, ~~is~~ a tributary of the Indus in the Potwar region, has preserved five terraces showing its past history and fortunately human tools have been found in association with these terraces. The first terrace (400 feet) and the third (120 feet) can be directly linked with the moraines of the II and III Glacial periods, making its chronology and stratigraphy certain. The human tools have been found in all the four top terraces. Here the stone tools can be divided into three main groups. The earliest called 'Pre- Soan' is found in the huge Boulder bed or conglomerate belonging to the II glaciation. The split pebbles have prominent bulbs of percussion and natural pebble surface as striking platforms. They are both massive and crude. De Terra and Paterson thought these flakes to resemble fairly with the cromerian eoliths of Europe which are also dated to the Mindel glacial phase. Many prehistorians doubted

1. Raza, M., "Environment and Culture of Palaeolithic Man in the Potwar Plateau", The Geographer, Vol.XVI, 1969, pp.9-19.

MAP OF THE POTWAR REGION SHOWING PRE HISTORIC SITES IN N.W. PUNJAB



Dentate line indicates mountain border +Sohan Industry ⊙ Pre Sohan artefacts Ⓘ Neolithic sites X Palaeolithic sites Madras Industry

FIG. 22

these tools as a true human culture, because these flakes bear no evidence of secondary flaking and therefore could as well have formed by the natural forces.[1]

The Soan culture, which followed the pre- Soan culture in the Punjab plains has been divided into Early Soan, Late Soan and Evolved Soan industries on the basis of patination and state of wear. The Early Soan industry, consisting of a series of pebble and flake tools, were collected in the Valley of Soan at Adiala, Khalsa Kalan, Chauntra and Trap near the juntion of Indus and the Soan and also in the Indus Valley at Ghariala, Khushalgarh, Makhod and Injra. It has been assigned to the later part of the second interglacial stage of Terrace 1. On the basis of the physical condition of the tools they have been sub-divided into three groups A, B and C. The earliest, A, is heavily patinated and thoroughly worn, B is deeply patinated like A but not worn, and the youngest, C is less patinated and fairly fresh. The three stages are characterised by a variety of (chopping and scraping) pebble tools, associated with a comparatively small number of flakes which increases in later stages. From the earliest to the latest stages there is a typological developmental trend (which

1. Bhattacharya, D.K., Pre-Historic Archaeology, 1972, p.115.

can not be based on stratigraphy) towards smaller and neater forms of various tool types. These tools fall into two categories- pebble tools and flake tools. The pebble tools are again sub-divided into two sub-types, (i) 'flat based' and (ii) 'round'- pebble tools.

The flat-based variety has a flat side produced by natural cleavage or artificial breaking. From this surface so flakes are struck off towards the upper rounded surface as to form a steep cutting edge. It is not known whether they were used for chopping or scraping. In the second round-pebble variety, the shape of the tool is dependent on the shape of the pebble (flattish oval or spheroidal). The flakes are struck from the original pebble surface not from any platform, natural or prepared, as in the former case. The cutting edge is worked on one side only, which produces a scalloped cutting edge. When the flaking is all round the periphery, it gives rise to highly evolved cores. The same types of pebble tools are found in all the three groups of the Early Soan but there is a tendency from group to group to produce neater and finer implements. No flakes were found in group A. In group B there are flakes also. They also possess unfaceted platforms with little retouch. Primary flaking of the upper surface is crude, often retaining the pebble cortex. Step flaking is common. The general impression is that the industry, viewed apart from the greater number of its pebble tools, has a resemblance to the Early Clactonian of Europe. In group C the commonest pebble tool is flattish with flaking on one surface half way around the periphery. A development of this form is a discoidal core flaked all over one surface, and is characteristic of this group. These resemble the clactonian forms and also the Early Levalloisean.[1]

Coming from T_1 to T_2 we have a new industry, known as Late-Soan, which is of third glacial age. The tools from the lower underlying basal gravel deposits of this terrace are called Late- Soan A, while those from the overlying silts are called Late- Soan B. The pebble tools of Late- Soan A, show a large variety but they are all better made than, and clearly developed from the Early Soan. They are associated with a far greater number of flake tools than in Early Soan and corresponding cores, the flake element being distinctly Levalloisean in technique with the clacton flake still prominent. Both flake assemblages have left corresponding series of cores. The retouching of the flake tools is comparatively small.

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1. Krishnaswami, V.D., "Stone Age India", Ancient India, Bulletin of the Archaeological Survey of India, No.3, Jan.1947,p.24.

The tools of Late Soan B are exceedingly fresh and in this there is no mixture of Abbevillio- Acheulean handaxes. This indicates the survival of the Soan tradition long after the biface industry had become extinct. Although pebble-choppers and cores are present as in A, this phase consists in the main of flakes and blades. Almost half of the flakes have faceted platforms without any signs of retouch. The rest are mostly blades or elongated flakes. This phase shows a general resemblance to the Late Levalloisean of Europe. The core tools in both of the Late- Soan series do not show any marked variation from those of the Early Soan except that here the tools tend to be thinner and neater than the latter, though basically these continue to represent a pebble based industry. Moreover, in this case some new typologies on pebble core are also identified, for example the turtle-back core or the discoidals. However the occurrence of discoid cores or discoid flakes is not common in this industry. The most significant character of Late- Soan consists in the appreciable increase in the proportion of flakes in this industry. Terrace 3 being erosional yields only the redeposition of the earlier tools. Terrace 4 though yields some tools which are not remarkably different from the Late- Soan, yet on the basis of their occurrence these have been called as Evolved Soan by Movius.

The Soan cultural complex, as it appears from foregoing, gave a succession of pebble core and flakes industries for the entire stretch of the Pleistocene beginning from the second interglacial.

Typologically the Soan has been divided, as already explained, into various phases, in the same way as Acheulean material has been grouped, but this does not indicate any progressive passage of time. In general terms, smaller sized Soan industries occur in geologically later phases, but typology ~~ally~~ alone here, as elsewhere, is no guide to chronology, Early Soan industries which have been recognized from a number of sites in the Indus watershed, contain choppers made on water-worn pebbles flaked either from a natural cleavage surface or from the original surface of the pebble itself, chopping tools with alternate flaked edges (bifacial) and irregular wavy cutting edges, discoidal cores and flakes. The flakes bear little signs of secondary retouch although utilization has left blunted edges and often cortex remains on the dorsal face. A small number of flakes show greater preparation of the core prior to flake detachment, and some examples of rudimentary prepared platforms have been reported.

'Late Soan' industries occur in gravels correlated with the third glacial phase of the Himalayan sequence, and some evidence suggests that Soan like industries were being practised as late as third interglacial times. The pebble tool element is reduced and flake artifacts make up a minor part of these assemblages; prepared core with faceted platforms occur and their flakes are associated with greater quantities of plain flakes with inclined platforms. Little secondary retouch has been recorded, but utilization traces are present. Soan industries in the northern Punjab appear to be typologically indistinguishable from assemblages in Pakistan ~~India~~ near Rawalpindi, and it may be that this area immediately south of the Himalayan glacial belt, represent a cultural province entirely distinct from the contemporaneous Acheulean traditions to the south. Soan like artifacts are claimed from many of these Acheulean industries but these are unlikely to indicate little more than a common method of preparing pebbles for work.

All the studies made to date seem to indicate that Punjab's earliest evidence of effective human occupation dates from the second Himalayan interglacial and that pebbles and flakes detached from pebbles represent the predominant trait of culture in this region. It may be emphasised here that such a situation has led many earlier workers to conclude that Punjab's Lower Palaeolithic or Early Stone Age development should fall outside the development of this age in the rest of India. However the merits and demerits of such a view cannot be examined until the Early Stone Age character of the rest of India is fully surveyed.

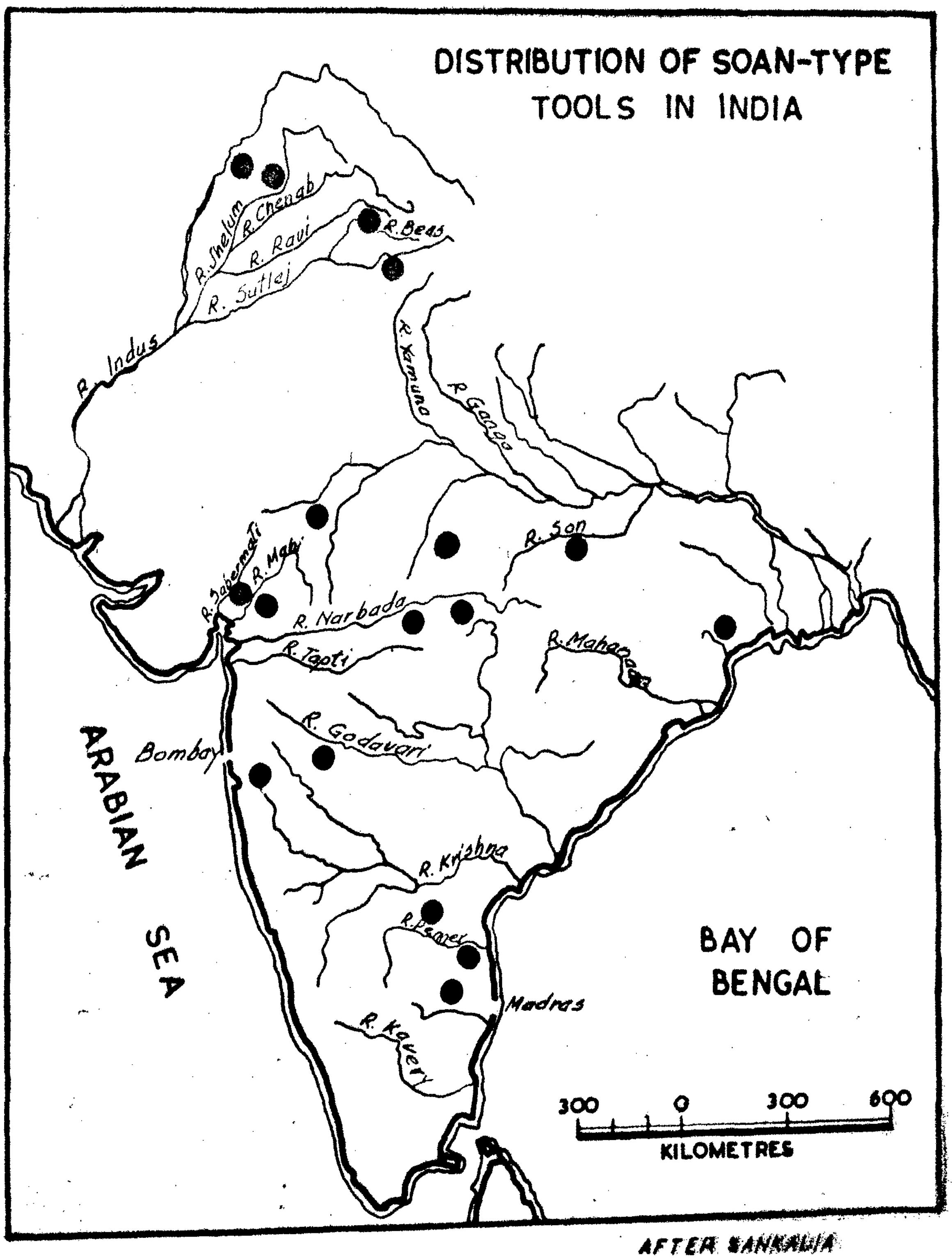
The peculiarity of the Soan culture as whole in contrast to other contemporary cultures of India is that it carries three lithic traits in integral association, pebble tools, pebble cores and flakes and that with rare exception it is generally free of biface (Fig.23).

Narmada Valley

The fluviatile deposits of the Narmada river have yielded much cultural and faunal material. Here de Terra and Paterson worked in 1935 and worked out a cultural succession, making the region a meeting ground of Soanian and Madrasian culture. Since then various expeditions by Indian archaeologists have been undertaken. De Terra's work gives the following picture of the environmental and cultural succession in the region.[1]

Since most of the peninsular rivers, unlike the Punjab rivers, carry only the water of the monsoon rains,

1. De Terra and Paterson., op. cit. pp.321-326



DISTRIBUTION OF SOAN-TYPE TOOLS IN INDIA
R. Jhelum
R. Chenab
R. Ravi
R. Beas
R. Sutlej
R. Indus
R. Yamuna
R. Ganga
R. Son
R. Mahi
R. Narbada
R. Tapti
R. Godavari
R. Krishna
R. Kavery
Bombay
Madras
ARABIAN SEA
BAY OF BENGAL
300 0 300 600
KILOMETRES
AFTER SANKALIA

FIG.23

the stratigraphic situations observed in the peninsula are slightly different. Almost all the rivers in peninsular India record two aggradation. The underlying deposit is called basal gravel or Boulder conglomerate, while the overlying deposit is called finer gravel. These gravels are separated by two groups of silts. Attached to the side of these four groups of strata, there is usually found a smaller terrace of black soil bording the modern river level. This is known as black cotton soil. Most of the central and eastern Indian rivers show a thin deposit of clay (often called mottled clay) over primary laterite below the first gravel.

The effect of high rainfall during the pluvial phases is recorded only in the form of the primary laterite formation. Subsequent to this, the second interpluvial is recorded in the form of the mottled clay. The third and fourth pluviations are recorded as the two aggradational gravels. The younger terrace is the earliest Holocene deposit and is black because of a general increase of humic acid in this period. It is thought that thick vegetation and its petrification caused the formation of this acid.

In this ancient alluvium the three different cycles of sedimentation are known as Lower group, Upper group and regur group and are exposed to a depth of 130 feet in the Narmada Valley as a terrace between Hoshangabad and Narsinghpur. The age of the three stage of Narmada alluvium with three stratigraphic breaks, has been based upon the correlatable similarity of gravel zones in terraces with their archaeological records, here and in the Potwar region/ (Fig.24 Here de Terra remarks that similar archaeological records could not have appeared in both these regions at different intervals. Each of the Lower and Upper Narmada groups begins with a basal gravel overlain by pinkish or orange-coloured concretionary clays and silts. There appears to be no change in fauna of both the groups but both are definitely Mid-Pleistocene assemblage (of Eurasian forms). In the Lower group the basal conglomerate is coarse and more cemented, the clay is more intensily coloured and also richer in concretions than the upper zone. Fossil mammals begin at the base of the Lower group and so does the archaeological record of ancient Man. From highly cemented basal gravels of Lower group large flakes with prominent bulbs reminiscent of the Pre- Soan industry of Boulder conglomerate zone of the Potwar have been found. The Lower group has also yielded both unworn and rolled Acheulean tools with heavily rolled Abbevillian handaxes and flakes of Early Soan. This would make the Acheaulean industry contemporaneous with the

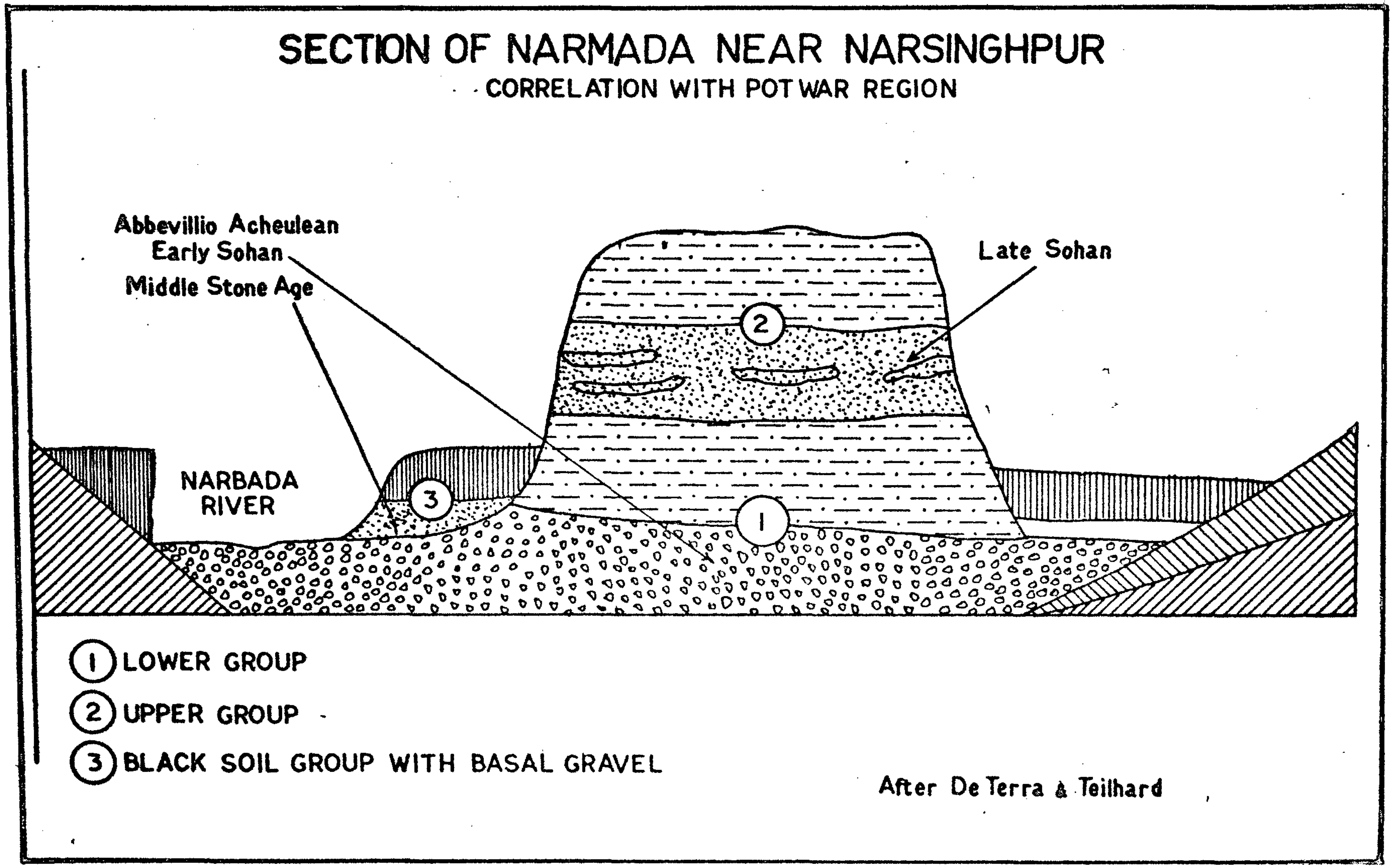

SECTION OF NARMADA NEAR NARSINGHPUR
CORRELATION WITH POT WAR REGION
Abbevillio Acheulean
Early Sohan
Middle Stone Age
Late Sohan
NARBADA RIVER
2
3
1
1 LOWER GROUP
2 UPPER GROUP
3 BLACK SOIL GROUP WITH BASAL GRAVEL
After De Terra & Teilhard

FIG 24

deposition of the basal conglomerate. From the red concretionary clay and silt overlying the basal conglomerate a fresh upper Acheulean biface and several unrolled flakes were collected by de Terra. On the basis of the correlatable similarity between the archaeological records we can say that terrace I of Soan Valley corresponding to basal conglomerate and terrace II to the (younger) pink concretionar clay, denoting the same age as in Soan Valley of Punjab.

The basal gravels of the upper group are less coarse and less cemented than those of lower group. Above this lies again a thic clay bed less red and poorer in concretions than the older clay. From the vicinity of Narsinghpur in both horizons of this group was a typical Mid-Pleistocene fauna. As in the lower group so in the Upper, there are two distinct industries both apparently derived from the Lower. But one of these, the biface industry, is Acheulian and rolled, pointing to redeposition from earlier gravels of the Lower group. The other industry which is fresh and unrolled and therefore contemporary with the Upper group, consists of fresh flakes, discoidal and pebble cores of quartzite and trap. These typologically fall within the range of the Late Soan industry of the north, apparently evolved from the Early Soan of the Lower

Narmada. The Upper group which is Late Soan and free from biface culture may therefore be regarded as synchronous with cultures of terrace third and forth in the Potwar.[1]

The Late Soan age tools are found throughout a thick layer of black soil which varies from 50 to 150 centimeters in depth and which sometimes lies on the earlier deposit, and sometimes on bed-rock (excavated at Adamgarh hill in Narmada Valley). In addition to the stone age industry there was a quantity of animal bones, mainly concentrated between 25 and 40 centimeters from the surface but also above and below this. Potsherds were found down to a maximum depth of 85 centimeters. There were also broken maceheads and pebbles which appeared to have been used as hammer stones.[2]

In view of the absence of clear terrace records in the Narmada region, it is not possible at present geologically to establish the concomitant individual synchronization suggested here on archaeological grounds between the successive soil zones of the Narmada with the terrace of Punjab. But these sequences are not without some geological

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1. Krishnaswami, V.D., Stone Age India, <u>Ancient India</u>, No.3, 1947, p.28.
2. Allchin, R. and Bridget., <u>The Birth of Indian Civilization</u>, 1968, p.83.

support. The three main erosion periods (disconformities) in the Narmada have their counterparts in the Punjab between Lower Pleistocine and the Boulder conglomerate, between the Boulder conglomerate and terrace I and between terrace II and terrace III. Even the aggradational stages terrace II and IV have their counterparts in the pink clay of the Narmada. The stratigraphic, faunal, climatic and archaeological sequence in the Narmada Valley, as visualized by de Terra and Paterson can be summarized and correlated as follows.

TABLE VII

Correlation of Quaternary Sequence in the Narmada Valley (after de Terra)

	Stage	Stone Age Culture		Fauna	Climate
	Cotton Soil Silt	Proto-Neolithic Microlithic (Mesolithic)		Present	Pluvial
Upper group	Pink clay	Late Soan		Narmada	
	Sand	Late Soan			Pluvial
	Erosion				
Lower group	Pink clay	Late Acheulian	Early Soan	Narmada	
	Conglo-merate	Abbevillio-Acheulian handaxe	Early Soan Chopper flake		Pluvial
	?	?		?	
	Laterite	?			Tropical

A later study[1] has also attempted a correlation of human industries with different deposits in the Narmada Valley, besides dating the series II and indicating their origin. According to this investigations red clay is the first horizon in the series. It was found exposed in relation to the Boulder conglomerate at only one locality-Mahadeo Piparia. No fossils were found though tools of a heavy type and of the chellean phase were found.

The red clay underwent extensive denudation before the next deposit were found. The unconformity is very clear in many places. This horizon is fossiliferous as well implementiferous. The tools exhibit the features of implements belonging to the Abbevillian and Early Acheulian. This formation occurs fifteen feet above the present water level. It seems that there was plenty of water in the river and aggradation took place extensively. Gradually the cemented sandy gravel is replaced by a sandy deposit. In these sandy beds advanced Acheulean tools were found "in situ". Along with these Acheulean handaxes and cleavers, series II artifacts are also found. It appears that the series II in this horizon is a new culture,

1. Khatri, A.P., "Stone Age and Pleistocene Chronology of the Narmada Valley (Central India), <u>Anthropos</u>, Vol.56, 1961, pp.519-525.

independent of the handaxe cleaver complex and that it is contemporary to it. They seem to have influenced each other. This seems to be confirmed by date from other places too in central India.[1,2]

The sandy layer mentioned above is overlaid by yellow silt, continuing upward conformably and above it is the black cotton soil. On the surface of the black cotton soil microliths were found. According to Khatri's above description, the mixed industry of rolled and unrolled tools together in different strata as supposed by De Terra in his 1935 study, should not be regarded as an established fact in Central Indian archaeology.

The relation between early human culture and Quaternary stratigraphy of the Narmada Valley, as put forward by Khatri, can be summarized as follows:

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1. Khatri, A.P., "Palaeolithic Industries of River Shivna", Bull Deccan College Research Institute, Vol.XVIII, pp.160-169.
2. Sankalia, H.D., "Animal Fossils and Palaeolithic Industries from Pravara Basin at Nevasa", Ancient India, Vol.XII, pp.35-38.

Chart showing Stratigraphic and Cultural Correlation in the Narmada Valley (after Khatri)

Period	Geological Formation	Archaeology
Holocene	Black Cotton Soil Yellowish Brown Silt with concretion	Microlithic
Upper Pleistocene	Deposition of cross-bedded sand (fossils)	Late Acheulian and Series II
	Cemented Sandy Conglomerate (fossils)	Late Acheulian to Early Acheulian
	Unconformity	
Middle Pleistocene	Boulder Conglomerate (fossils)	Earliest phase of the Chellean found in both the deposits
	Red Clay	
	Laterite (?)	

It appears that Khatri's observations on Narmada stratigraphy in the Hoshangabad - Narsinghpur region were not correct. A preliminary survey in 1963 by Sankalia[1] showed that de Terra's observations were correct though no where does one findthe succession of all the six or seven deposits mentioned by him or the Laterite at the base of the besal gravel. Khatri's main contention was that red

1. Sankalia, H.D., Pre-history and Proto-history of India and Pakistan, 1974, p.115.

greasy clay was the earliest deposit and further that there was a development of the handaxe industry from the pebble tools. So far as the first point is concerned, it may be said that possibly the Narmada stratigraphy is complicated because it is a rift valley and the whole problem of river stratigraphy needs careful reappraisal. Khatri's second contention that at Mahadeo Piparia there is an Oldowan type pebble-tool industry which gradually developed into a handaxe-cleaver industry also does not seem to be correct as it is not borne out by detailed excavation of the site by Supekar.[1] In fact no where in peninsular India tools have been found in the red concretionary clay or in the brown silt layer above the second finer gravel. What is certain is that in the Narmada, as elsewhere in India, Acheulian type handaxes and cleavers appear together with those made on pebble and pebble flakes though the proportion of the latter might vary.

Sabarmati Valley

Saurashtra, Gujarat and Kutch were certainly inhabited by man during Early Stone Age. Of these area

1. Sankalia, H.D., ibid, p.119.

the best studied region from the view point of stratigraphy and Early Stone Age cultural sequence is in the Sabarmati Valley in northern Gujarat. This river valley has also the distinction of being the first area in peninsular India to be studied by modern geochronological method.[1]

Sabarmati has its origin in the Aravalli and flows southwest ward to the Gulf of Cambay. In order to understand the pattern of Early Stone Age cultures in Gujarat it is necessary to know the stratigraphy of the Sabarmati. The evidence suggests the following succession of deposits and climatic phases.[2]

(P) Allitic weathering and formation of lateritic crust, climate more humid than at present, a hilly landscape.

(Q) Molted clay deposited in the basin of the river bed. Climate not of the Lateritic type.

(R) Cemented gravel phase. The river carries pebbles and deposits them as a sheet. Climate characterized by seas and floods, precipitation some what heavier. Palaeolithic man present.

(S) Silt phase. The river builds up its bed by shedding sand and silt. Climate becoming drier, run-off

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1. Zeuner, F.E., The Stone Age and Pleistocene Chronology in Gujarat, 1950.
2. Ibid., p.23.

decreasing. Palaeolithic man present.

(T) The red soil phase. The aggradation having drowned part of the ancient land surface, the river has been able to shift its bed. A red soil is formed, covering exceedingly flat new land surface formed by aggradation. Climate probably more humid than previously, with dry forest or scrub covering the country. The climate was however less humid than during the Laterite phase (P). Palaeolithic man vanishes from the scene.

(U) Main dry phase. Once more river begins to aggrade and lays down fine silt and brown sand derived from the arid land surface away from the river. Gradually river action becomes less conspicous and aeolian deposits and sand begins to dominate. Climate becoming drier again culminating in the arid period.

(V) After the end of the dry phase, a flat land surface was formed by sub-aerial denudation. Apparently a phase of some what damper climate.

(W) Dry phase: Climate a revival of drier conditions.

(X) Pre-pottery microlith phase. Man reappears as microlith maker.

(Y) Last dry phase. This phase is somewhats of a doubtful character, as it may either be due to a slight increase in aridity of the climate or to man's destructive influence on natural vegetation. Pottery makers present, agriculture highly probable.

(Z) Modern phase, climate like that of X, with prolonged dry season but sufficient precipitation to maintain soil formation by chemical weathering undercover of dry forest.

It will be noticed that this sequence of alternating damper and drier phases, on the whole, shows a trend towards greater aridity as one approaches the present day. In the valley mixed industries of pebble-tools, biface and flake tools occur in two implementiferous horizons - the cemented gravel phase (R) and the overlying silt phase (S). The sequence also shows that since the formation of the palaeolithic gravel Northern Gujarat has not experienced any period which had a rain fall heavier than the present.

In the Sabarmati lithic complex no typological succession is observable but pebble tools characteristic of the gravel disappear from silt.[1] Crude tools occur alongside finer ones and new distinct evolution is

1. Raza, M., "Age and Environment of Stone Age Man in Peninsular India", Geographical Outlook, Vol.VII, 1971-72, p.20.

recognisable. Besides pebble tools and Abbevillian-Acheulian types of biface, discoid cores and numerous flake occur, which recall the Soan. The proportion of core and flake elements appear to be equal or slightly in favour of the later. Zeuner describes the Sabarmati industry as a combination of Late Soan and Middle to Late Acheulian elements. The nature of contact is yet to be determined.

The Sabarmati tools, on typological grounds, can be correlated with the Late Soan of de Terra's Potwar cultural sequence.[1] Assuming this correlation to be correct, the Sabarmati industry would approximately be homotaxial with the third glacial (Penultimate glaciation of Zeuner), which is the age of the Late Soan industry in the Potwar. Such a dating would be considerably late and would bring the handaxe-cleaver cultures in Gujarat to the end of the Middle Pleistocene or to the begining of the Upper Pleistocene. But looking at the evolved nature of the industry right from the gravel stage, this dating is not unreasonable.

To summarize, Early Stone Age Man arrived in Gujarat during a phase of the Pleistocene when the climate

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1. Zeuner, E.F., op.cit., p.43.

was slightly more humid than at present and the vegetation cover thicker and that he had brought with him and advanced technology of handaxe and cleaver making.

<u>Orissa</u> (Burhabalang and Brahmani Valleys)

Though it cannot be said with reasonable certainty that the whole of Orissa was inhabited by man during the Early Stone Age, his lithic records have been discovered from many river valleys of the region. The best studied localities are the valleys of Burhabalang[1] and Brahamani.[2]

Archaeological work in the Burhabalang Valley in Mayurbhanj has been confined to Kulina and the surrounding valleys. The stratigraphy of the area can be summarized as follows:

The primary laterite is overlain by secondary laterite, which in turn is capped by a thin layer of superficial clay. All these rest above the formation of a massive clay. Deposits of gravel and boulder have been observed in the bed of the river at several places. At Kamta, on the eastern bank of the river, alluvium and thin boulderbeds alternate with one another.

1. Bose, N.K. and Dharni Sen, <u>Excavations in Maymbhanj</u>, 1948.
2. Mohapatra, G.C., <u>The Stone Age Cultures of Orissa</u>, 1962.

Tools have been found from excavation at Kulina and Kamta and from laterite gravel quarries at a number of places. Their general characteristics can be summaries as follows:

(1) The earliest tools seem to have been choppers with straight or convex working edges.

(2) Choppers were followed by bifaces of irregular form and flake tools with unprepared striking platform.

(3) After this came much more neatly worked bifaces of regular form and then a few rather crude cleavers. One interesting fact at this stage is that choppers of an earlier type continue to exist side by side with more regular tools. But these choppers show a decided improvement in technique.

The total number of artifacts found is 663. Of these 12.12% are pebble-tools, 81.29% core tools and 6.48% flake tools.

From the above it appears that the industry of Kulina is mainly a core industry with an important addition of pebbles and a small admixture of flakes. Handaxes and chopper predominate. Flake tools on the whole are few. A very small number, however, show a Levalloisian technique.

Thus tools of an advanced type are, on the whole few in comparision with primitive ones.

Probably the Kulina industry extended over a period when skill in flaking quartzite or in producing regular forms was not very highly developed. Though a distinct growth in skill is attested, the majority of the tools is characterized by mediocre skill. This may indicate that progress was restricted during considerable period of time.

Archaeological work in the Brahamani basin and several other rivers also find evidences of three wet phases separated by three dry phases. The Pleistocene record in this region open with a wet phase. Man was absent during this phase. The dry phase which followed may or may not have human population, but deposits of the next wet phase contain indubitable evidence of man, viz. his tools.

The general Pleistocene stratigraphy of these river valleys is as follows:[1] over the bed rock a layer of mottled clay occurs which is covered by a deposit of cemented coarse gravel (gravel I); then follows a thick layer of red silt which in turn is underlain by another layer of gravel (gravel II). A huge deposit of silt appears at the top.

1. Ibid, p.50.

The stratigraphic horizons of the different Stone Age industries are very clear. The coarse gravel yields the tools of Early Stone Age cultures.

Technologically the Brahmani Valley Early Stone Age tools are divisible into three stages. The first stage represents the beginning of Early Stone Age cultures of the area. These tools show a very crude technique. In the second stage tools show a markedly improved technology. The culmination of this technological development is reached in the third stage.

The typology of the tools suggest that, on the whole, the Brahmani Early Stone Age culture belongs to the tradition of bifacial tools in which the flake and pebbles form an integral part. Combined together they form one assemblage of tools which belongs to the Early Stone Age culture without an independent existence of their own.

Like the Kulina industry, the Brahmani collection is also characterized by a mediocre skill. But the percentage of the pebble-tools resembling those of the Soanian chopper-chopping industry at Kulina is not met with in the Brahmani Valley.

Like Kulina handaxes also predominate in the Brahmani Valley. Cleavers are strikingly few and scrapers are mainly found in the minature variety.

Madras and other Regions

The best known sequence of Stone Age cultures of Pleistocene in peninsular India comes from the coastal plain near Madras. Here there is a system of terraces in the Pleistocene deposits corresponding to the terrace system in the Siwaliks. These terraces have been examined in detail in relation to the archaeological sequence of the artifacts contained in them.[1] The terraces studied belong to the Korttalayar Valley (Old Palar), which was examined chiefly in two areas, one including Erumaivettpalaiyam, Attirampakkam, Naunbakkam and other sites, the other including Vadamadurai Boulder conglomerate bed. The coastal plain was formed by laterite, as in Orissa, during the Early Pleistocene times. Over this was deposited by the Korttalayar a white Boulder conglomerate at Vadamadurai. This was overlaid by the detrital laterite. The older river

1. Krishnaswami, V.D., Pre-historic Man Around Madras, (Indian Academy of Science Meeting), 1938.
"Environment and Cultural Changes of Prehistoric Man near Madras", JMGA, Vol.XIII, 1938, pp.58-90.

valley was then dissected and three terraces at heights 60, 20 and 8 feet respectively were created. The highest level, T_0, which is 100 feet above the stream level in the Korttalayar Valley, is an aggradational laterite plain (Fig.25)

At Vadamadurai the lithic record is divisible into three groups, based on patination and typology. They are: the early group, the second group and the third group. The earliest group is non-laterized, with heavy cream coloured (cortex) patination. The tools are rolled, of pre-laterite age and contemporary with the Boulder conglomerate, they are subdivisible into two sub-series.

(a) Early Series: Handaxes and cores with a heavy white (cortex) patination; Abbevillian type of handaxes, crude and irregular with thick pebble butts and much cortex. Primary flaking denotes stone technique producing deep irregular flake scars with little or no retouch. Cores are very large and irregular and of no definite types. Flakes indicate primitive flaking with much cortex.

(b) Late Series: The tools are less patinated than the previous series. They show typologic advance, especially in cores. Handaxes resemble Early Acheul and are regular in form. Though free flaking is common, step

PREHISTORIC SITES IN KORTTALAYAR VALLEY NEAR MADRAS

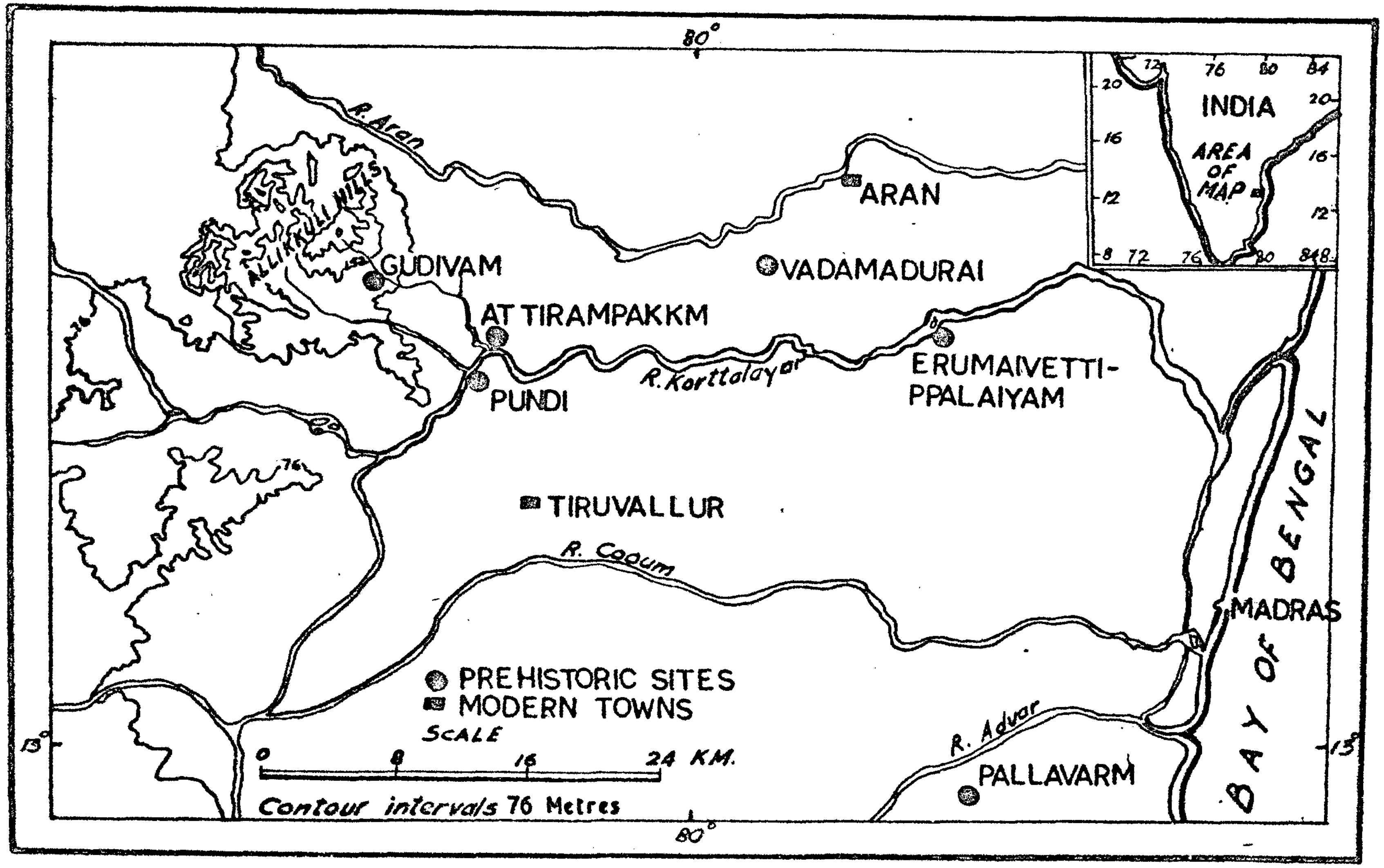

FIG. 25

AFTER SANKALIA

flaking begins. Cores are mostly discoidal with fairly regular alternate flaking. Flakes show absence of faceting of platforms, less cortex, more primary flaking in upper surface than in the Early Series but still no retouch.

The second group is stained red through contact with laterite gravel laid down on top of conglomerate. They show definite typologic advance on the earliest group. Handaxes resemble Mid-Acheul type, flatter and neater, with more step flaking; pear shaped and ovate forms being very common. Cores mainly discoidel in type as in the Late Series of the First group, but with more regular flaking. Flakes show more primary flaking and none has a faceted platform.

The Third group has no laterite staining, but a little patination. Handaxes made by wood technique resemble upper Acheul. Cleavers are very few in this group. Flakes are thin but still show no sign of faceting on the platform, a few retouched as side-scrapers.[1]

At the terrace at Attirampakkam we find a further developed form of the biface (Late Acheulian) alongside

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1. Krishnaswami, V.D., Stone Age India, Ancient India, Bulletin of Arch. Sur. of India, No.3, 1947, p.33.

core and flake tools correlatable with the Late Soan of the third glacial age. In all the phases we find the biface predominates over flakes and pebble tools.

The archaeo-stratigraphic sequence near Madras can be summarized as follows:

1. Primary Laterite Plain: non-implementiferous.

2. Boulder conglomerate with three Groups of tools as under:

Early Group: Non-Laterized, with heavy patination. Tools rolled but divisible into:

(a) Early Series: Abbevillian handaxes with pebblebutt and crude and irregular flaking.

(b) Late Series: Less patinated handaxes of Early Acheulian type.

Second Group: Tools stained red but not patinated; fine Acheulian handaxes. Pear and ovate shapes appear.

Third Group: No laterite staining; handaxes with by cylinder hammer technique. A few cleavers.

One thing about this sequence and relative position of various industries may be noted here. Even in the

Early Group wesee a mixture of Abbevillio-Acheulian and Early Soan elements. This corresponds with the position elsewhere in Indian handaxe world. We do not see, as in East Africa, the step by which the handaxe evolved from the earlier pebble tools.

The laterite peneplain at Vadamadurai has not yet been climatically and faunastically dated but on the basis of archaeological evidences the age of Soan terrace I (second interglacial) can be assigned to this horizon.[1]

The term 'Madras industry' has been given to the predominant handaxe industry of south India, as Stellenbosch typifies that for South Africa. De Terra has christened the north India flake-chopper facies of the Palaeolithic as Soan and for the sake of scientific brevity, the term Madras industry here denote this biface industry (with its type fossil - the handaxe) in the Lower Palaeolithic cultural complex of south India.[2]

<u>Inland Region of Deccan</u>

Besides the Madras region, we have vast collection of Old Stone Age artifacts from Kurnool in the Deccan

1. Raza, M., op.cit., p.19.
2. Krishnaswami, V.D., op.cit., p.35.

Plateau (Andhra), where Burkitt[1] classified the tools into four series, as belonging to distinct cultures of differing dates from Early Palaeolithic to Proto-Neolithic times. The four cultures are:

(4) Microlithic Industries: This series includes crescent, triangles, scrapers and cores which are also met with at Polavaram on the Godavari river as well as Banda and in the Vindhyan hills.

(3) Blade and Burin Industry: Slender and with blunted backs, with a few burins, planing tools and end-scrapers, closely allied to 4. Their material is lydianite.

(2) Flake Industries: Mixed with neatly made handaxes and made of quartzite, sandstone and chalcedony. Less weathered than 1; found at the eastern and the western end of the Nandikanama pass.

(1) Earliest Biface Industries: Consisting of handaxes and cleavers of various types closely paralleled among similar finds in Africa.[2]

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1. Burkitt, M.C. and Cammiade, L.A., "Fresh Light on the Stone Age of S.E.India", Antiquity, Vol.IV, 1930, pp.327-329.
2. Krishnaswami, V.D., op.cit., p.31.

The work of Burkitt and Cammiade had suggested a fairly good sequence of Stone Age tools and climatic fluctuations. Since then this region, as well as other near by regions have been more fully surveyed.[1] In the light of our present knowledge of the region it seems that here we have at least two cycles of pluvial and interpluvial phases after the formation of the laterite. The stratigraphic sequence together with their lithic record can be summarized as follows:[2]

Upper Pleistocene	Fine gravel not laterized	Tools of series II (Middle Pal.)	Wet phase V
	Fine gravel and clays	Advanced handaxes and Levalloise Flakes	Dry phase IV
Middle Pleistocene	Coarse River gravel	End of Handaxe of period I	Strong wet phase III
	Open plains	Handaxes of period I	Dry phase II
Lower Pleistocene	Laterite formation on East Coast	Non-implementiferous	Long wet phase I

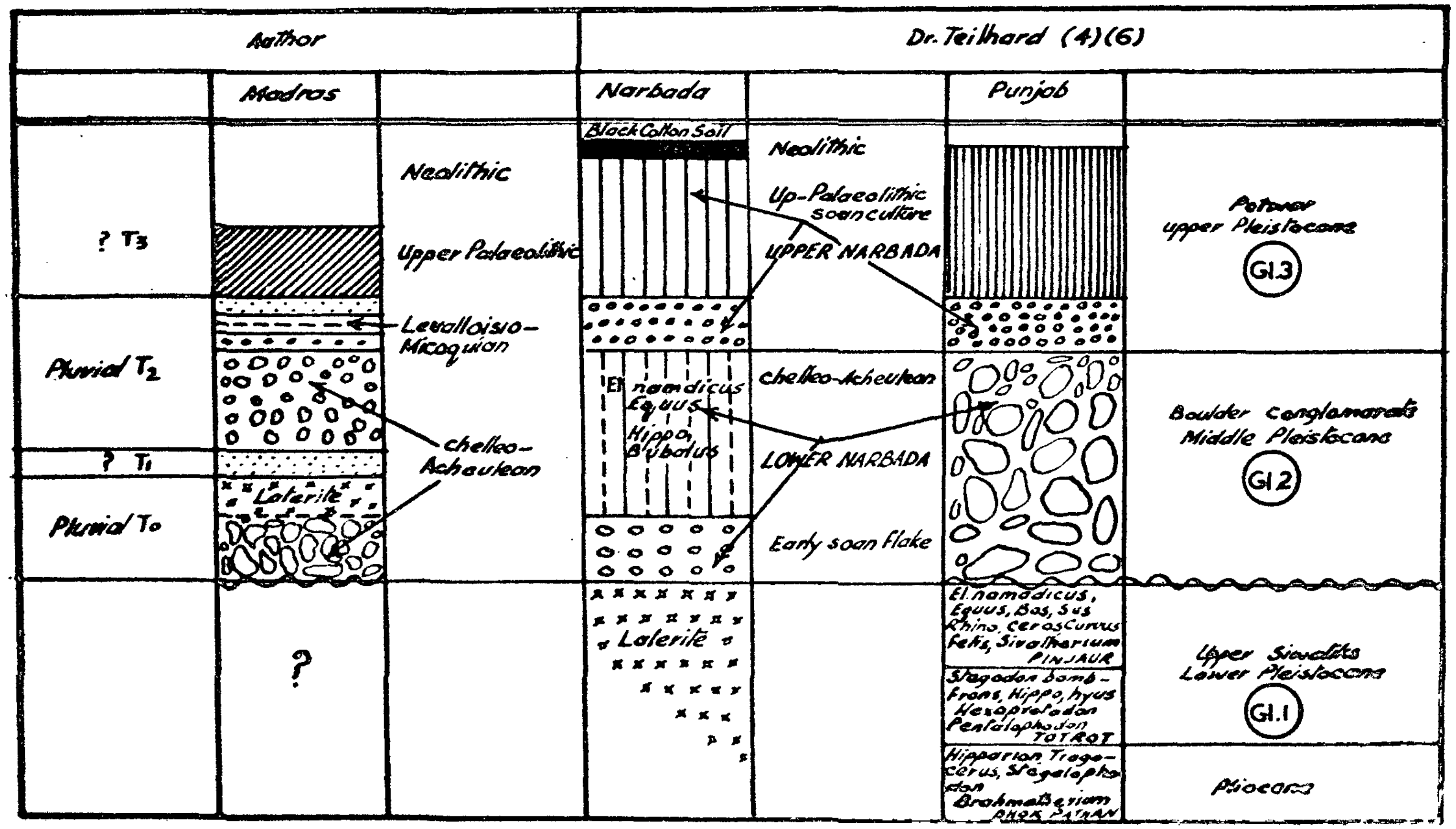
1. Issac, N., The Stone Age Cultures of Kurnool, Unpublished Ph.D. thesis Poona University, 1960.
   Soundra Rajan, K.V., "Stone Age Industries near Giddalur" Ancient India, No.8, 1952, pp.64-92.
2. Sankalia, H.D., Prehistory and Protohistory of India and Pakistan, 1974, p.57.

Early Stone Age: General Observations

The whole of the sub-continent has produced evidence of Early Stone Age cultures, characterized by the wonderful handaxe, cleavers and chopper-chopping tools. The first glaciation and the first interglacial in the North and their corresponding climatic phases in the South are conspicuous for their lack of human industry. The Early Stone Age archaeolithic sequence in the North with the primitive Pre-Soan flakes in the Boulder conglomerate stage of the Upper Siwalik, date back to the second glaciation. In the South the earliest lithic horizon also comes from the Boulder conglomerate overlying laterite (Fig.26). The exact date of this lithic horizon is not yet fully determined but on archaeological and other grounds the age of the second glaciation has been assigned to it. The earliest southern lithic complex is characterized by crude pebble tools, biface and flake (Abbevillio Early Acheulian). Whereas in the South pebble tools and biface make their appearance during the second glaciation, in the North they do not do so untill the second interglacial.

During the second interglacial (T_1) a pebble-flake and biface complex, termed Early Soan arises in the North.

DIAGRAMMATIC REPRESENTATION OF THE DISTRIBUTION OF HUMAN INDUSTRIES IN THE PLEISTOCENE FORMATIONS OF THE NORTH-WEST, CENTRAL AND S.INDIA



AFTER KRISHNASWAMY

FIG. 26

In the succeeding third glaciation (T_2) the biface apparently disappears and is replaced by developed flake tradition (Late Soan). During the last interglacial (T_4) there is a further development of the Late Soan (Evolved Soan). By end of this period the Evolved Soan disappears.

During the Middle Pleistocene on the east coast, the biface shows further development, the cleaver makes its definite appearance and the pebble tools continue. All tool families show appreciable typological development. The first terrace stage in Madras, which probably belongs to the second interglacial, Early Soan type of tools are revealed besides a continunity and development of the biface (Upper-Acheulian). Perhaps corresponding to the third glacial time Late Soan elements appear in Madras area in second terrace stage. There is also a remarkable development of biface and cleaver by core flake technique, as revealed at Attirampakkam terrace.

The same elements seem to appear in Gujarat during the third glaciation. Before the end of the last interglacial the biface disappears and an advanced flake industry appears.

In central India, in the Narmada region a similar lithic cultural record occurs during the Middle Pleistocene, corresponding to Early and Late Soan. Early Soan elements with a biface complex appear in the Lower Narmada group. Typologically correlated with the Soan, the Middle Pleistocene Lower and Upper Narmada industries would fall in the second interglacial and third glacial respectively. Probably during the third glaciation, a mixed industry appear in Gujarat which shows a contact and probable fusion of Late Acheulian and Late Soan elements.

Although the spatial and vertical distribution of Early Stone Age cultures in India is not yet perfectly understood, the following tentative generalizations can be made:

(1) Emergence of a pebble-flake tradition in North, free of the biface during the second interglacial, its continuity and development till the third interglacial and its distribution south-ward in variable frequency in other parts of India at different times.

(2) Emergence of a pebble-tool complex in the South during a phase corresponding to the second glaciation, alongwith the biface core- tools, perhaps a little earlier than later,

its continuity in the second interglacial and subsequent absorption by the biface.

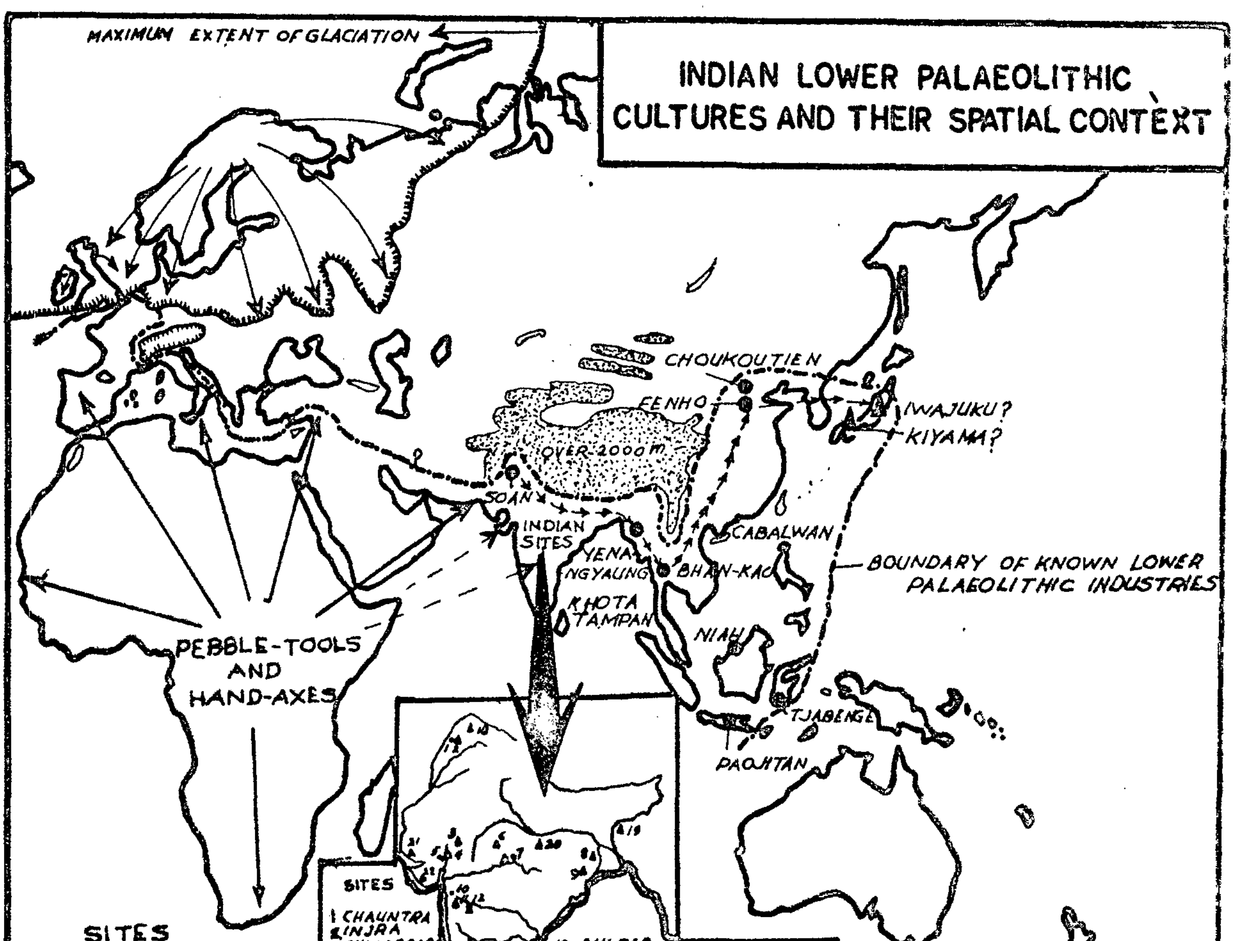
(3) Emergence of a biface core-tool tradition in the South during the second glaciation, its continuity and development till the end of the third glaciation and its distribution in varying frequencies in other parts of India at different times.

(4) Appearance of the cleaver with in the above tradition in the second interglacial or a little earlier and its continuity and subsequent distribution in intimate association of the biface.

(5) Integration of the core-flake technique in the South, specially in the later stages, of the biface-cleaver development during the third glaciation.

(6) Contact of the southern biface-cleaver tradition and the northern pebble flake tradition in various parts of India during the second interglacial and third glacial time. Probabilities of fusion between the elements of the two traditions in the riverine regions on the northern borders of the peninsula and in the river systems of Gujarat and adjacent tracts of the Deccan.

Many writers, following Burkitt and Cammiade, have pointed out, that Early Stone Age industries of peninsular India closely resemble those of Southern and Central Africa. They share an almost universal choice of quartzite as raw material, a high proportion of cleaver in relation to handaxes than seen in Europe. The handaxe and cleaver on flake, however, appear in India at a later stage than in Africa. The pebble tool complex appear in peninsular India at about the same time as the Kafuan-Oldowan in Africa. Compared to other Asian countries the Soan tradition of North India is broadly contemporaneous with Choukoutienen and Anyathian. The Early Soan, the Early Anyathian and the Choukoutienen are dated within the second interglacial (Fig.27).



AFTER SANKALIA

FIG. 27

CHAPTER V

MIDDLE AND LATE STONE AGES

Till quite recently the Indian Middle Stone Age was an enigma. The barrnness, with few exceptions, of the rocks overlying those containing the handaxe- cleaver complex had led to the supposition that India lacked a Middle Stone Age and that the cultural sequence had passed from Early Stone Age right into the Late Stone Age in sub-recent time. However recent discoveries made of new types of tool complexes at Navasa on Paravar river in Ahmadnagar district as well as the river valleys of several other districts of Madhya-Pradesh, Rajasthan, Orissa, Andhra Pradesh and Maharashtra have changed the picture and have given India a well characterized, stratigraphically attestable Middle Stone Age culture. These tools have been found in deposits which lie between those containing handaxes and those containing microlithic industries, in the cemented gravel of the second aggradation cycle.[1]

At several sites, notably Navasa on the Paravara, Nandur Madhmeshwar on the Narmada and Tandrepadu near

1. Allchin, B., "The Indian Middle Stone Age: Some new sites in central and Southern India and their implications", Bull. Institute of Archaeology, Vol.II, 1959, pp.1-36.

Karnool these tools have been confidently correlated to Terrace II.[1] This shows beyond any doubt that stratigraphically these industries succeed the handaxe and precede the blade and burin industries of the Late Stone Age. A great deal of work still remains to be done on this question but the sequential position of these industries as a whole is clear and there are number of sites at which transitional assemblages or a continuous sequence in terms of stratigraphy and typology from Early to Middle Stone Age have been found.

General Characteristics

The most conspicous characteristics of the Indian Middle Stone Age is that it is a flake tool culture, a tradition which may well have developed locally out of the handaxe and chopping-tool industry of the Early Stone Age. The tool making technique shows considerable development. Two principal methods of obtaining flakes from cores are distinguishable. In the preceding Early Stone Age tools were made either on flakes, or on pebbles or on cores first by 'free' and later by 'controlled' flaking leaving the resultant flakes with high angles and prominent bulbs. In

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1. Banerjee, K.D., Middle Palaeolithic Industries of the Deccan, Ph.D. thesis University of Poona, 1957 and Joshi, R.V., Pleistocene Studies in the Malaprabha Basin, 1958.

the Middle Stone Age a mixture of many techniques was used. Two principal methods of obtaining flakes were more common. The first is that of striking flakes from carefully prepared disc-shaped or oval cores reminiscent of the Levallois-Mousterian of Europe. The resulting flakes are round or oval. The second method was to strike triangular, square or oblong flakes from rather less carefully prepared cores. These cores, which are often river pebbles, some times look like descendants of chopping tools of Early Stone Age. It is the blade flakes struck from these cores that have sometimes been erroneously described as blades. But both the preparation of the core and the method of removing the flakes differ fundamentally from that seen in the blade industries of Western Europe, Western Asia and parts of East Africa. What the relationship of the two techniques seen in India may originally have been is not clear but by the end of the period there is little doubt that in many cases they formed part and parcel of the same industry.

Cores of both the groups appear to have been utilized as chopping tools or scrapers and the majority of the flakes were clearly used either as scrapers or cutting tools. In some cases this is shown by systematic use- marks along one or more of the edges and in others by delibrate secondary trimming to produce a particular type of steep working edge. In this way also flakes were turned into beaked, hollow or convex scrapers or into cutting or chopping tools. In the later part of the period specially the secondary work is often fine and controlled.

Tool Types

The main types of tools during the Middle Stone Age were as follows:(Fig.28).

(1) Scrapers of several types

(2) Points

(3) Borers

(4) Handaxe (occasional)

(5) Heavy duty tools like choppers (very rare)

It appears that the most common tool during this period was scraper. The tool frequency distribution from a number of important sites of peninsular India was as follows:[1]

(1) Scrapers 57.3%

1. Banerjee, K.D., op.cit., p.145.

MIDDLE STONE AGE TOOLS

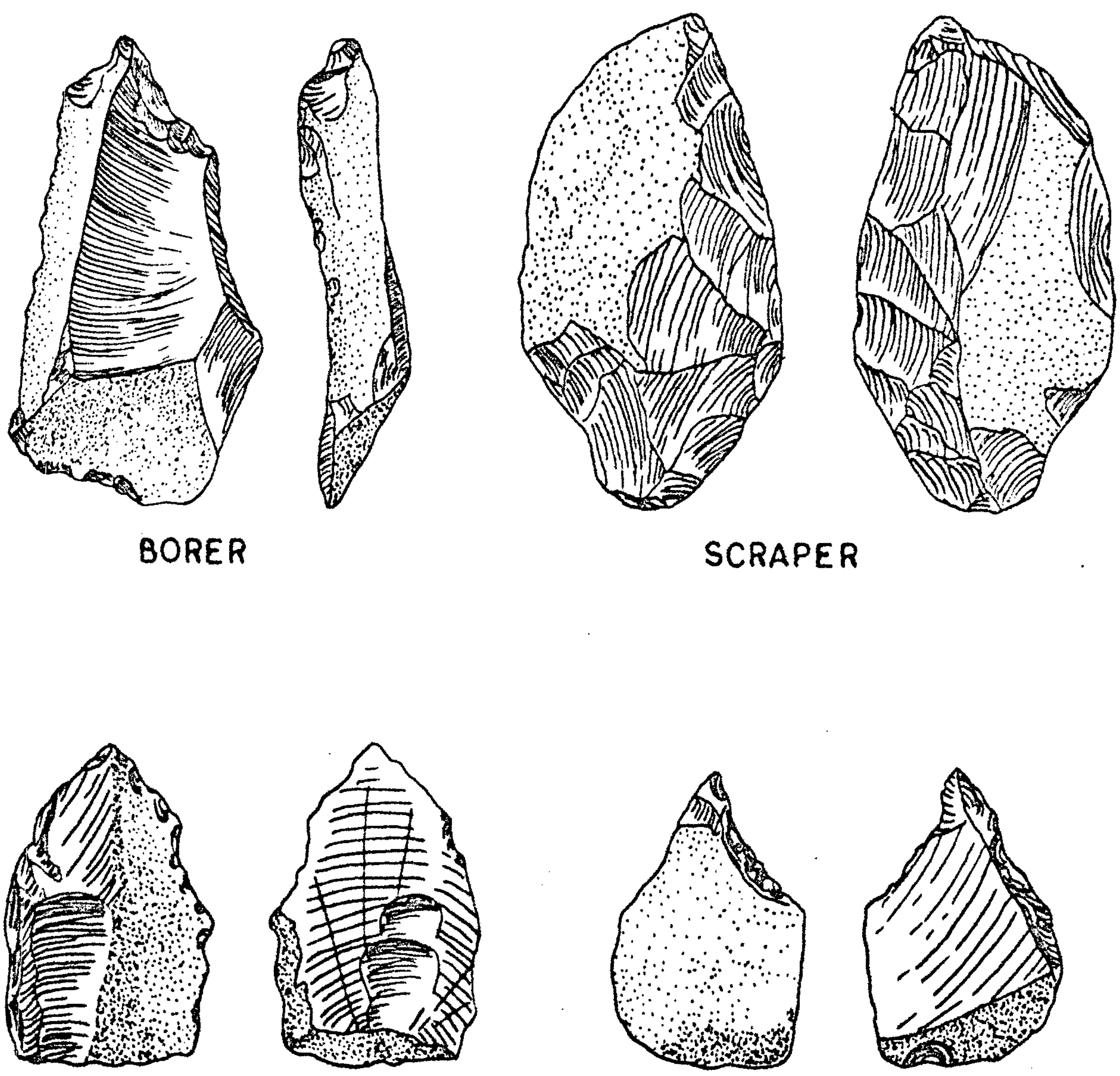

FIG. 28

(2) Borers 24.9%

(3) Points 15.7%

(4) Scraper cum borers 2.1%

The majority of scrapers have straight or slightly convex working edge, hollow and beaked forms also occur regularly. Points are comparatively rare and show none of the development of form seen in Middle or Upper Palaeolithic Europe. This means that points were not characteristic tools of this period. They also do not show any tendency to conform to an established type as in comparable industries in many other parts of the World. This may imply that some other material other than stone was employed as misile points and in all probability this material might have been same kind of hardwood. In south-east Asia even to this day bamboo and other hardwood are widely used for a variety of purposes. Similar practice may well have prevailed in Middle Stone Age India where it can be seen as a natural corollary of the general character of the stone industry of the period, which for the most part consisted of wood working tools.

Handaxes are very rare in the Middle Stone Age tool complexes. They are occassionally found during the early phase but are conspicuous by their absence in the later phases.

Regional Distribution

The Middle Stone Age complex covers, by and large, the greater part of peninsular India. A perusal of tools from various sites reveals a well marked regional variation, especially during the later phase. It appears that the caves of central India, which have yielded abundant Late Stone Age material, were not occupied by Middle Stone Age man as no specifically Middle Stone Age tools have yet been found in them. But in western India near Bombay,[1] in central Deccan[2] and in extreme south, Middle and Late Stone Age tools have been found at closely related sites in a manner which suggests an unbroken tradition. These would give the impression that the change from one group of techniques to another was effected without a sudden break; by the acquisian of new techniques, rather than by a sweeping change.

As of now a large number of Middle Stone Age sites have been discovered from many parts of the country but an

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1. Todd, K.R., "Microlith Industries of Bombay", Ancient India, Vol.VI, 1950, pp.4-16.
2. Allchin, B. and Satayanaran, "A Late Stone Age Site near Kondapur, Andhra Pradesh", Man, 1959, p.301.

examination of the distribution map of Middle Stone Age sites reveals that a remarkably high proportion of sites occur in a few districts of Maharashtra, Karnatka, Andhra Pradesh, Rajasthan, Saurashtra and Kutch.

In Maharashtra Middle Stone Age sites are located in all the districts of Khandesh, Marathawada, Vidarbha as well as Western Maharashtra including Konkan and Goa. The most important stratified site is Nevasa on the Paravara.

In North Karnataka formerly only one or two stratified sites were known, the most important being Taminhal and Almatti. Later the sites of Kovalli and Anagwadi were discovered. A number of sites belonging to this phase are known from the Shorapur doab in the Gulberge district. They include both factory sites and stratified sites.

The classical site of Kurnool occurs in Andhra - Pradesh where Burkitt and Cammiade had made their typological classification of Stone Age tools. Later other sites were discovered at Bel Pandhari on the Godavari and Maheshwar on the Narmada. Two other districts of Andhra, Chittor and

Nalgonda have yielded Middle Stone Age sites. One of the richest of such sites in Ramatirathampaye on Krishna.

In Tamil Nadu the sites of Attirampakkam and Vadamadurai, well known for their Early Stone Age cultural content, have also yielded Middle Stone Age tools. At the former site the detrital laterite gravel contains a post - Acheulian flake industry.

In Orissa stratified deposits of this phase exist on the Khadkai at Bejatala and Kandalia in district Mayurbhanj, at Ramla and Jagannathpur on Baitrani in district Keonjhar, at Jhirapain on Kuel, at Khurhadi on the Khurhadi in district Sundergarh and at Hari-Chanderpur in district Dhenkanal.

In Bihar Middle Stone Age tools come from the districts of Patna, Gaya, Bhagalpur, Monghyr and Chotanagpur.

So far only two sites have yielded tools of this period in Uttar Pradesh - Chepan on the Son in Mirzapur district and Patawanjor near Rewa. More sites may be discovered, specially in the southern districts, as they are but the continuation of the same geological formation as found in eastern Madhya Pradesh which have yielded tools of the phases.

The important sites of Madhya Pradesh are Sihore on the Dhasan, Gonchi on the Betwa, the Valleys of Sonar, Kopra and Bearma in the Damoh district and a number of sites on the north- eastern most extension of the Vindhya hill. The entire area from Jabalpur to Amarkantak is also very rich.

In Rajasthan tools typologically comparable with those of the Middle Stone Age come only from the western part of the state. This anamoly might be due more to a lack of systematic exploration than to any real absence of this culture in eastern Rajasthan. The most important centre of Middle Stone Age culture in western Rajasthan is the Luni Valley which alone has yielded some eight sites.

In Gujarat the Sabarmati Valley, which was an important centre of Early Stone Age culture has surprisingly not yielded evidences of the Middle phase. This may be primarily because after the Early Stone Age the region came under a dry spell which has not yet ended. In south Gujarat two sites have been discovered in Balsar district. Both Saurashtra and Kutch have yielded sites of the Middle phase.

Outside the peninsula Middle Stone Age tools come from the Potwar[1] region and the Kangra Valley.[2] The Middle

1. Paterson, T.T. and Drumond, H.J.H., Soan, the Palaeolithic of Pakistan, 1962.
2. Mohapatra, G.C., "Preliminary Report of the Exploration and Excavation of Stone Age sites in East Punjab", BDCRI, 1966, pp.224-229.

Stone Age culture also occurs in the Kashmir Valley as indicated by the discovery of the characteristic tools near Pahalgam.

Outside the country Middle Stone Age tools have been reported from Sanghao Valley near Peshawar in Pakistan.[1] The Sanghao flake industry of Levalloiso-Mousterian character is said to be widespread in northern Gandhara, occuring particularly in caves. Dani thinks that this industry is genetically connected with that of Iran and Iraqi Kurdistan rather than to the upper Soan of the Punjab. From Peshawar Valley these industries later proceeded southward.

The above account of the geographical distribution of Middle Stone Age cultures clearly shows that this phase of the Old Stone Age was very widespread in peninsular India. It covered the whole of Maharashtra, Karnataka, Tamil Nadu, Andhra Pradesh, Bihar and Uttar Pradesh (excluding the Ganga Valley) Madhaya Pradesh, Western Rajasthan, Gujarat and Saurashtra, Kashmir, Punjab and the Frontier Province of Pakistan. The occurence of this

1. Dani, A.H., "Sanghao Cave Excavation", Ancient Pakistan, 1964, pp.1-50.

industry, near Peshawar not only extends its limits but brings it to the very fringe of the Levalloiso- Mousterian cultures of the Middle East.

Late Stone Age

As the Late Stone Age in India is entirely post-Pleistocene, it is outside the scope of this work. But for the sake of continuity its salient feature are briefly given here. This phase is characterized, throughout India, by microlithic industries. The tools range from extremely fine assemblages of blades and geometric forms in central India though similar but crude varient industries in western India and the Deccan to the curious blend of Middle and Late Stone Age techniques in the extreme south.

The production of microliths involves a fluted core from which a large number of parallel sided flakes are taken out. The flakes so removed are comparatively small, not more than an inch and are often retouched by secondary working either on one edge or both. Normally microliths comprise cores, parellel sided flakes, scrapers of many types, triangles, burins and lunates. A distinction is sometimes made between geometric microliths comprising mainly of triangles, trapeze etc. and non-geometric.

Microliths are quite widespread but as yet they have not been found in Assam, Bengal, the Ganga Valley, the plains of the Punjab, Western Orissa and Rajasthan. In the present state of our knowledge it is difficult to say whether the blank regions are so because of want of exploration or some geographical reason. Their absence in areas like Assam may be due to a forest environment or a lack of suitable raw-material may explain their absence from the Ganga plain.

The raw material for the Late Stone Age microlith industries in the north and west is almost always some form of crypto-crystalline silica or some other rock which gives the same kind of smooth concoidal fracture when struck. Often it is in the form of semi-precious stones such as jasper, agate or carnelian, with the result that the smaller and more delicate tools have almost a jwel like appearance. By contrast, from Mysore plateau southward the predominant rawmaterial is quartz. This raw material is also employed in the Late Stone Age industries of parts of eastern central India but it is not clear whether there is any direct connection between these regions and those where it is used in south. Attempts have been made to divide these two groups into 'geomatric' and 'non-geometric' industries, the quartz industries being generally 'non-geometric'.[1]

In view of the intractable nature of quartz for the purpose of striking off flakes and blades from prepared cores, its use for making microliths is curious. This is specially so when we consider the fact that quartz was not the only material available and other more tractable stones were to be had. It's choice may suggest two things, either it was selected for other than purely practical reasons or it was chosen because some special method of fracturing quartz was employed which overcame the difficulties implied in its crystalline nature.

We, as yet, do not have any specific evidence of the relationship of Middle and Late Stone Age cultures. We are also hampered by a lack of precise evidence so far as the age of these cultures is concerned. It has been argued on geochronological and archaeological-stratigraphic ground that a very high antiquity may be assigned to the quartz industries of eastern and southern India.[2] The suggested

1. Lal, B.B., "Birhanpur, a microlithic site in the Damodar Valley", Ancient India, Vol.XIV, 1958, pp.4-48.
2. Lal, B.B. and Lal, S.B., "The Microlith Site of Birhanpur: A Geochronological study", Ancient India, Vol.XVII, 1961, pp.37-45.

date of 4000 B.C. or earlier for the coastal industry from Tinnevelly, Tamil Nadu, is used to support this argument.[1] A C^{14} date of around 2000 B.C. for an early Neolithic settlement in southern Deccan in no way conflicts with this date because a quartz industry has been found stratified below an early Neolithic settlement at one site. In Gujarat also microliths have been found stratified below an Indus Valley settlement. In a number of regions, therefore, the Late Stone Age cultures definitely proceded the earliest settlement and this probably was the general pattern. What we do not know, however, is howlong microlithic cultures held sway in different regions before the advent of settled communities.

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1. Zeuner & Allchin, "The Microlith Site of the Tinnevelly District, Madras State", Ancient India; Vol.XII, 1951, pp.4-20.

CHAPTER VI

STONE AGE MAN IN INDIA

Physical Type

Abundant quantities of lithic tools dating back to the Pleistocene period and discovered from practically every part of the country prove beyond any doubt that Pleistocene man existed in India. But what these men were like, whence they came and what happened to them, are all problems in regard to which positive knowledge is practically nill. The physical attribute of the Pleistocene humanity of India must remain, pending discovery of authentic skeletal remains, in the realm of scientific conjecture.

In view of the fact that during the preceding Miocene-Pliocene period India was inhabited by numerous anthrapoid apes with characteristics diverging towards the human type, the total absence of the hominid skeletal materials from Pleistocene beds is intriguing. One such was Ramapithecus punjabicus, a pan-sized primate with short face, arluate plate and dental and facial features resembling Australopithecus africanus. If circumstancial evidences are to be believed, the creature might have been a tool using animal and partially biped.[1] Ramapithecus was a wide ranging and mobile creature and was present in India, Africa, Europe and China. Lewis, in 1934, had classified Ramapithecus under the family Simiidae but had clearly emphasized its hominid character, when he stated that "while this Siwalik genus is still ape---------- it is almost on the human thresh-hold in its anatomical character".[2]

In view of the above one would have expected skeletal evidence of the earliest hominids in India comparable to that found in East Africa. But in the absence of such an evidence one can only call upon the logical interpretation of the origin and dispersal of the earliest human races to help him in the difficult task of understanding the physical types of men present in India during the Pleistocene period.

Some anthropologists suggest that different types of Stone Age tools suggest the geographical distribution of

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1. Khatri, A.P., "Early Fossil Hominids and Related Apes of the Siwalik Foothills of Himalayas: Recent discoveries and new interpretation," in Palaeoanthropology, Morphology and Ecology; Edited by Russel, H. Tuttle, 1975, p.50.
2. Lewis, G.E., Fossil Anthrapoid Apes of the Yale-Cambridge Expedition of 1935, Carnegie Institute of Washington, Pub.495: 1-27.

different types of early man. Movius,[1] for example, divides the palaeolithic world into two self contained archaeological realms, each belonging to a distinct group of men- early Homo and Pithecanthropi.

The fact that the Indian Stone Age has not been characterized by a tool distribution dichotomy, such as in Europe, and that the principal types of tools are found in integral association with one another in all parts of the country, has led many to surmise that the Indian Stone Age population was a mixed one, consisting of early representatives of Homo as well as more archaic type.

Pending discovery of skeletal materials, one method of forming some idea of the physical attributes of the Mid-Pleistocene hominids in India would be to study the type of men associated with similar tools elsewhere in the world on the presumption that genetically related palaeolithic tool families might not have been the handiwork of altogether different types of men.

In the present state of our knowledge it appears that the mixed palaeolithic population of India arrived from

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1. Movius, H.L., "The Lower Palaeolithic cultures of S.E.Asia", Jr. Amer. Phil. Soc., New Series, 38, pp.329-420.

Africa as the centre of man's evolution and early dispersal probably lay there. Long before anything was known of man's ancestors in Africa, Darwin shrewdly remarked, "it is somewhat more probable that our early ancestors lived on the African continent than elsewhere".[1] Coon has also suggested that the main centre of the evolution and dispersal during the Pleistocene was the region consisting of the present Sahara desert of East Africa and Southern Arabia.[2] Therefore despite the lack of conclusive evidence, it is believed that the first human occupation of the earth was probably in East Africa. The early development of the handaxe culture in Africa, as well as early migrations into Europe and Western Asia from Africa tend to confirm this assumption (Fig.29).

Apparently, the first human's date from the early part of the Ice Age and in Mid-Pleistocene they broke free from their original homeland, having acquired the requisite tools and abilities. In a few thousand years man reached many parts of the earth which were remote from their original home, including India.

No one knows exactly why early man migrated from his original homeland but it appears that from the earliest times

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1. Darwin, C., The Descent of Man, 1871, p.199
2. Coon, C.S., The Story of Man, 1954, p.41.

THE MAJOR MIGRATIONS OF MAN, ASSUMING THE ORIGIN WAS IN SOUTH-CENTRAL AFRICA

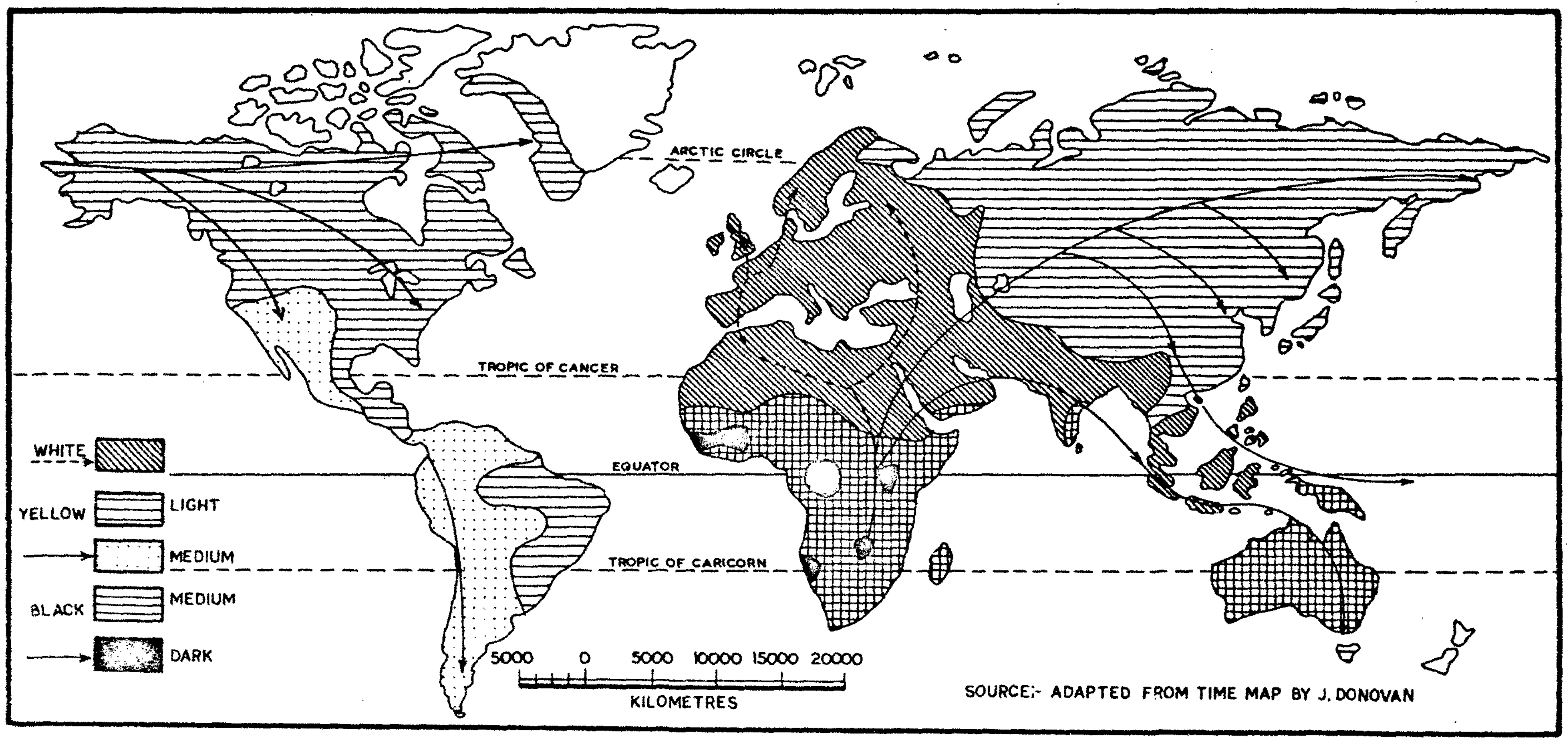

FIG29

man was prone to wander. Evidently migration is normal form of human behaviour. Men migrate for various reasons such as negative pressure of over-population or climatic change or positive attraction of other areas. In primitive times when most of the people were hunter and gatherers, probably everyone migrated.

There is clear evidence of these early migrations although there was no written record of them. In the first place, the present racial distribution of people must be explained in terms of these migrations. The spread of certain physical characteristic such as a skin colour, hair form, head form etc. indicate the general direction of many of the migratory people. Further evidence is to be found in the study of the artifacts of man.

When primitive man began to migrate from his original homeland they probably moved overland. In most of the migrations man moved along slowly, gradually extending his range of hunting and gathering. On the basis of fossils and artifacts it is possible to trace the routes of many of these migrations in general, if not in detail. It appears that in the first phase of migration, probably from 1,000,000 to 500,000 B.C. man occupied eastern and northeastern Africa, southwest Asia, India, China and Java. It appears certain that man advanced from the humid tropical climate of his original homeland into the deserts and steppes of southwest Asia and into the tropical climate of India and the temperate climate of China.

In the light of the above it is suggested that the mixed Indian Pleistocene population could have come only from the west and that its different elements - the Soan, the handaxe and the Levalloisian came in that order and that only the first effectively crossed the Movius line[1] into southeast Asia where it evolved on its own (Fig.30).

Since India was an integral part of the archaeological realm extending from Africa to southeast Asia, Indian Mid-Pleistocene population could not but have been a local variant of the physical types found in these regions.

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1. A geographical frontier running down the spine of Asia, to the Pamirs, east along the northern flak of the Himalayas then south along the frontier of India on Burma into the Indian Ocean. Although it may have been breached few times and in more than one place before the end of the Pleistocene, on the whole self contained archaeological traditions evolved on either side of it.

CLIMATE AND CULTURE DURING THE PLEISTOCENE

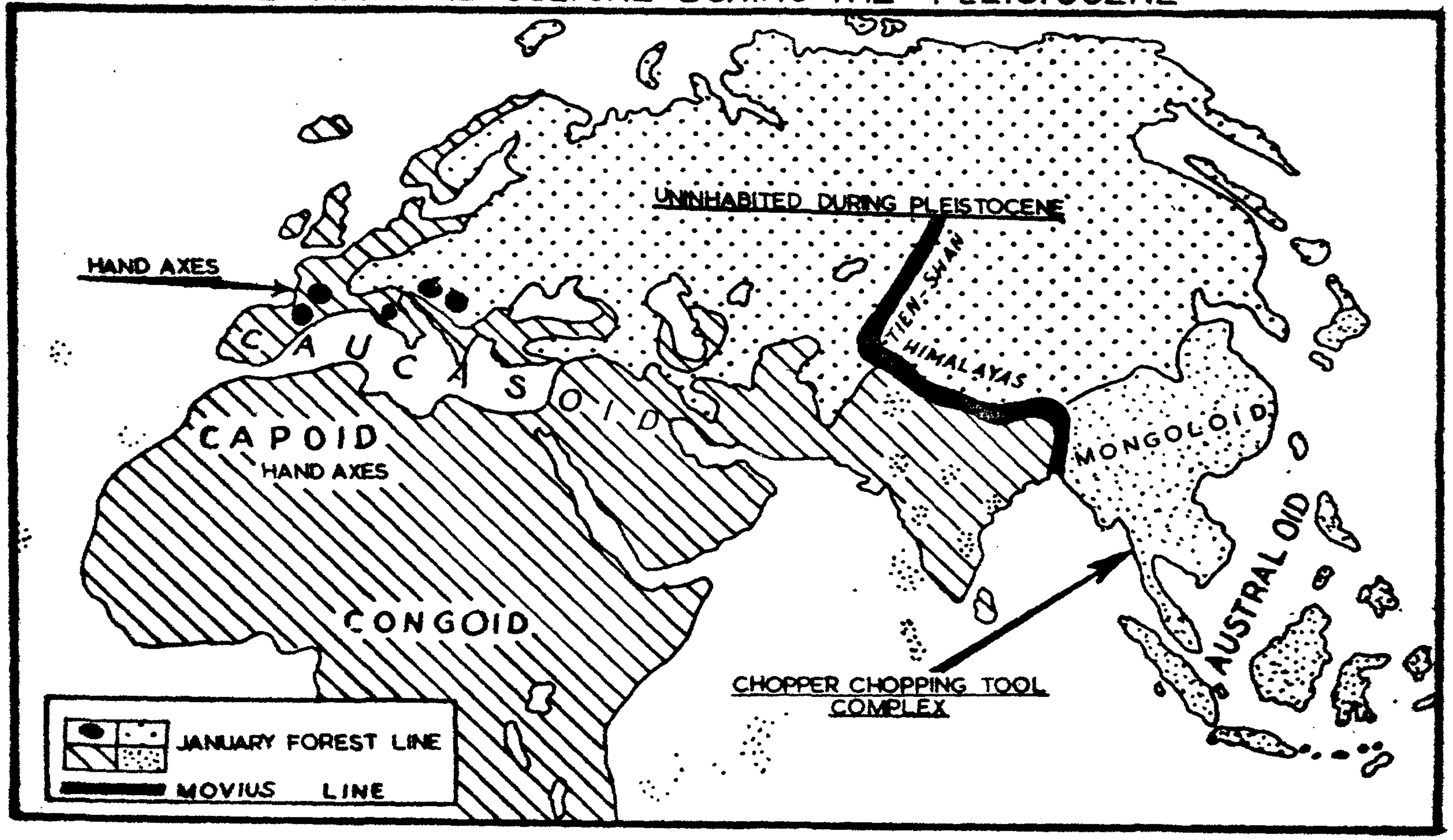

FIG.30

Table VIII

Regional varieties of advanced hominids found in Africa and Asia were as follows:

Regional varieties of Pleistocene Hominids

Approximate time years B.P.	East Africa	S.Africa	N.Africa	Java	China
Possible Transition groups					
900 - 550,000	Olduvai Bed I H. habilis	Swartkaran (Telanthropus) habilis		Kendung Brubus Meganthropus erectus?	
Established groups					
550 - 350,000	Olduvai Bed II (Chellean) H. erectus		Ternifine (Atlanthropus)	Modjokertian Trinil Pithecanthropus	Choukoutian Sinanthrapus

The above hominids can be assigned to one or more species of early men. The more archaic type, Pithecanthropi, probably in its early stage was not limited to Asia and Java but extended as far west as north Africa. Atlanthropus-manritanicus, coming from Algeria, represent an evolutionary stage analogous to that of the Pithecanthropi of East Africa.[1]

Also in east Africa and other parts of the continent such as south Africa, Angola and north Africa there are to be found in geological deposits which belong to the Kageran pluvial at the very beginning of the Pleistocene, very crude flake pebbles (such as are associated with the Pithecanthropi of East Africa).[2] Charlesworth is also of the same opinion. "Men of the Pithecanthropus- Sinanthropus stage of physical evolution extended seemingly down east Asia from Peking to Java and north wards to north India and east Africa, they had a culture of chopper- chopping tools".[3] (Fig.31).

The early and lower Mid-Pleistocene deposits of east Africa, apart from Australopithecine, which have long been recognized as partially hominized group, contains the remains of two different types of fossil hominids- Homo habilis and Homo erectus.

Homo habilis fossils were discovered from Bed I of the Olduvai gorge sequence. The remains were found associated

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1. Boule, M. & Vallois, H.V., Fossil Men, 1957, p.424
2. Leakey, L.S.B., Adam's Ancestors, 1963, p.66.
3. Charlesworth, J.K., The Quaternary Era, Vol.II, 1957, p.843.

DISTRIBUTION OF EARLY MAN FROM HIS FIRST APPEARANCE TO ABOUT 50,000 YEARS AGO

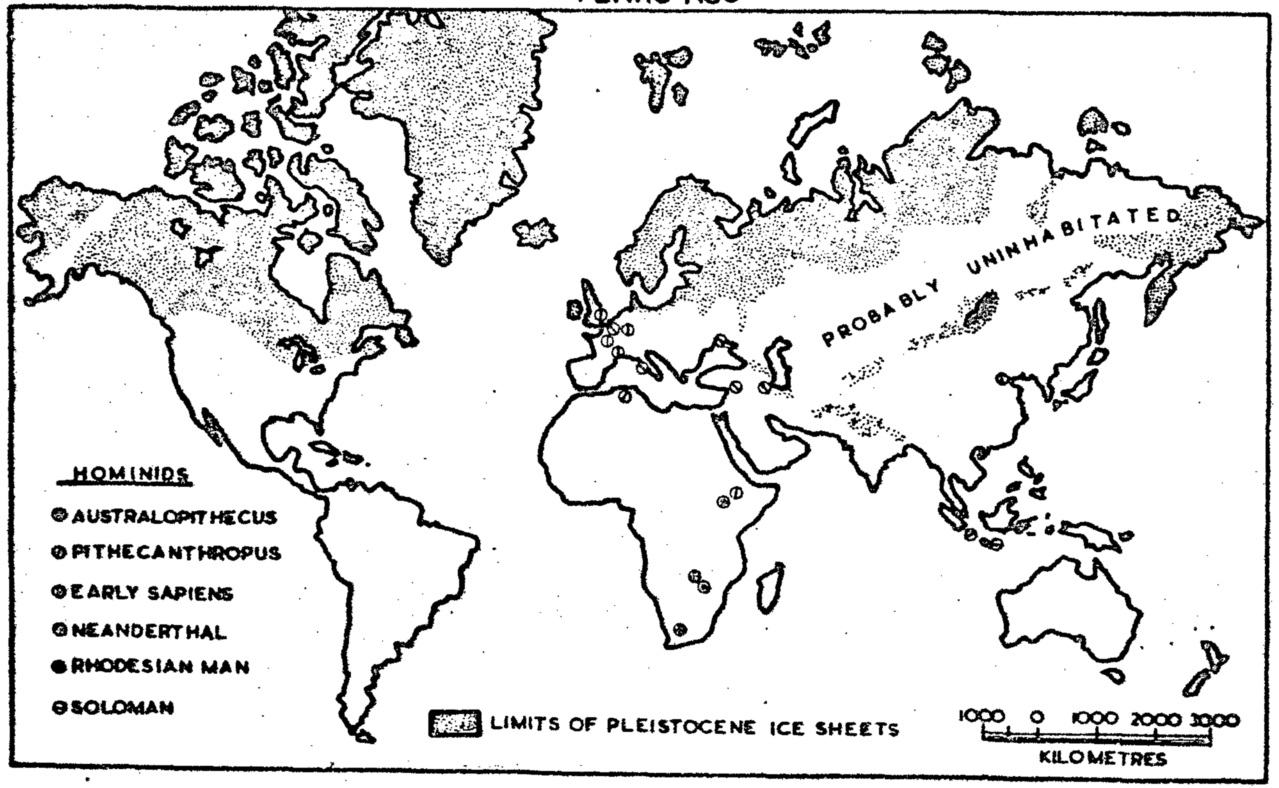

FIG. 31

with primitive stone implements commonly made on pebbles. This hominid,probably collateral of some of the early inhabitants of India,was pigmy sized with a relatively large cranial capacity (675-680 CC), reduced and narrow teeth and a number of markedly hominian features in limbs.[1]

The other Olduvai hominid, Homo erectus, came from the Mid-Pleistocene Bed II of the Olduvai gorge sequence. His remains were found in association with the earliest specimens of the second major tool family of the Stone Age-the Abbevillio-Acheulian handaxes. Remains attributable to H.erectus have been recognized in Mid-Pleistocene sites from a wide geographical area. This wide spread dispersion is an important evidence of the great biological adaptability of this species by comparision with its forerunner, the Australopithecine. It follows that material coming from so wide an area would be expected to exhibit a substantial degree of regional subspeciation.

The salient features of H.erectus may briefly listed in terms of primitive and advanced characters; these reflect its intermediate status between Australopithecine and H.Sapiens.[2]

1. Tobias, E.A., "Early Men in East Africa", in Readings in Anthropology, Edit. Jennings and Hocbals,p.99.
2. Weiner, J.S., The Natural History of Man, 1971, p.89.

Primitive Features

1. Bones of cranial vault very thick.
2. Strongly developed Supra- Orbital torus.
3. Receding frontal bones.
4. Well developed occipital torus.
5. Broad nasal bones.
6. Pronounced sub-nasal prognathism..
7. Absence of projecting chin.
8. Large upper incisors.

Advanced Features

1. Cranial capacity overlap the lower range found in *H.sapiens*.
2. Foramen magnum is positioned more anteriorly than in *Australopithecine*.
3. Dental morphology more like *H.sapiens*.
4. Incipient development of chin.
5. Limb bones in size and proportions indistinguishable from those of *H.sapiens*.

In the light of the above discussion it now appears more probable that the entire early and Mid-Pleistocene archaeological realm extending from Africa to China, was characterized by at least two clear cut series of hominization in which there might have been local variants: (a) a habilian grade from Africa, perhaps corresponding to Meganthrapus in Asia and (b) an erectus grade probably divisible into two: (1) an earlier Homo erectus grade represented in Africa by remains from middle Bed II of Olduvai and by Talanthrapus from Swartkrans and in Asia by the Djetis fossils in Java; (2) a later H.erectus grade represented in Africa by the "Chellean Man" of upper Bed II in Olduvai and in Asia by the Trinil and Choukoutian fossils.

India's Mid-Pleistocene population could not but have been derived from the above types and untill more convincing evidences are forthcoming to support Asia's claim as a possible centre of human evolution and dispersal, this generically mixed population could have come into the country only from the west. The Olduvai gorge is of great significance in this regard in showing beyond question that the Abbevillian culture grew out of the ancient pebble culture by the second glaciation and from there its creators carried it into different parts of the world.[1]

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1. Wooley, L. & Hawkes, J., History of Mankind, Vol.I, p.68.

Search for the remains of Pleistocene Man in India

The theoretical discussion in regards to the physical types of found in India's Mid-Pleistocene population may be corroborated or have to be altered if and when the search for the fossil remains of this ancient population yields some positive results. Since 1960 intensive investigation and search is going on under a research scheme financed by the Council of Scientific and Industrial Research (CSIR). The project, aimed at discovering fossil man in India, for the first time brought together geologists and pre-historic archaeologists. It made a thorough search of the caves, rock shelters, Pleistocene deposits and implementiferous and fossiliferous deposits. The area selected were in the Siwalik foothills in the north, the Narmada Valley in the middle and the Eramalai hills of Kurnool in south- areas very well known for their rich contents of Pleistocene fossils and Stone Age tools (Fig.32).

The most promising area appears to be the Siwalik hills which have a worldwide reputation of being one of the most important centre of evolution of sub-human primates. This area has already yielded some four genera and ten species of anthrapoid apes covering a time interval Mid-Miocene to Early- Pleistocene. There is no little doubt that the Siwalik

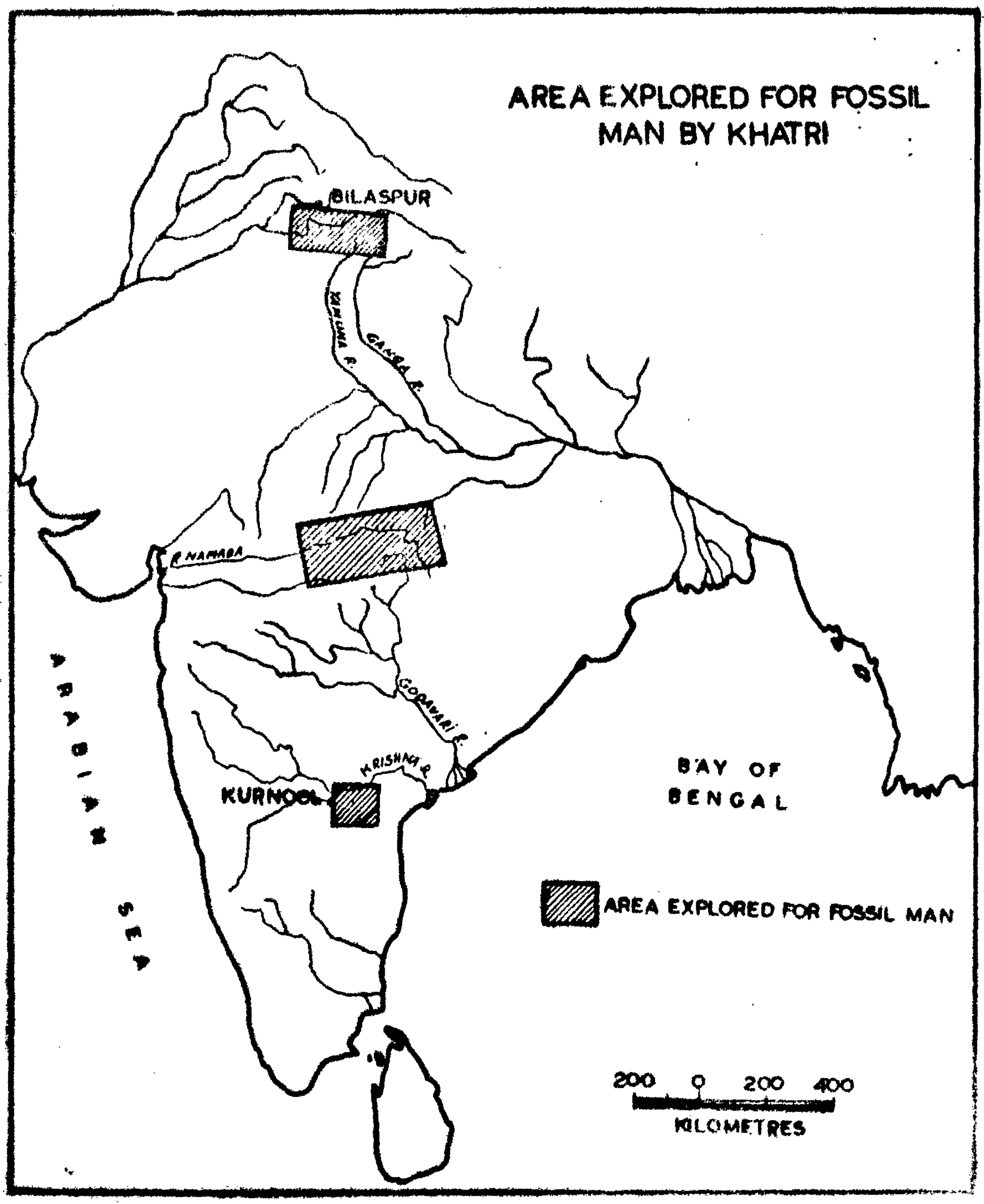
AREA EXPLORED FOR FOSSIL
MAN BY KHATRI
BILASPUR
GANGA R.
R. NARMADA
GODAVARI R.
KRISHNA R.
KURNOOL
ARABIAN SEA
BAY OF
BENGAL
AREA EXPLORED FOR FOSSIL MAN
200 0 200 400
KILOMETRES

FIG.32

foothills were the home of a vigorous and highly differentiated anthropoidae at a time when the first hominians must have been in the process of differenciation. The presence of these highly developed sub-human apes might suggest the presence of Early Man himself in the region. But so far the search has been futile.

The whole of the Narmada Valley is highly implementiferous but only in the Narsinghpur- Hoshangabad region in the upper portion of the valley fossil- artifact association has been established. This area is therefore regarded as highly promising and might someday yield the much sought after fossils. As a matter of fact it was here that Theobald actually found a skull in a conglomerate bed which he thought to be that of a fossil man. This precious find was, however, subsequently lost.

In 1959-60 an area lying between Hasalpur near Hoshangabad and Mahodeo-Piparia in Narsinghpur district was intensively investigated. A rich collection of fossils and Stone Age tools was made but no discovery of hominid fossils was made.

Search for fossil man was carried out in the Kurnool caves in 1962 in the famous bone caves of Billasurgam and other groups in the vicinity of Kurnool town in Andhra Pradesh.

The Billasurgam caves were first reported to the scientific world in 1840's by Captain Newbold and were later explored by Bruce Foote and Cammiade. Besides the Kurnool caves the Sagileru Valley was also explored by Khatri but though large number of Stone Age tools were discovered bones of the fossil man remained as elusive as ever.

Premordial Colonization and Habitation Pattern

In a country like India with grossly inadequate archaeological exploration, delimitation of geographical distribution of prehistoric population is a risky venture. The very limited number of localities with palaeolithic industries in suitable context greatly limit any conclusion about spatial distribution. However the problem imposed by low sample density can be ameliorated by pooling significant items of evidences from different fields and by delving into the theoretical work done in the sphere of palaeolithic archaeology. But it may be pointed out here that neither the geographical nor the archaeological data are yet in a state to allow anything more than a general observation. Nevertheless, a general idea of the premordial colonization and habitation pattern may be gained by preparing a good distribution map of Stone Age sites with dateable context. This would reveal that palaeolithic sites were closely dependent (1) upon valleys of the major rivers and (2) availability of suitable sources of stone for tool making.

The premordial habitation pattern was no doubt determined by abundance, diversity and ease of securing food and water and availability of suitable raw material for tool making. These conditions were mainly provided by river valleys. If this is the right trail they take us into areas of accentuated relief, of varied and abundant and useful fauna and flora, both riverine and terrestrial.

So far as the choice of river valleys is concerned, preference for them must have been due to the ease of securing food and water. It is not accidental that Chelles - Acheul sites are invariably found near water and often near good source of raw material for making tools. In Africa also, the distribution of cultural evidence suggest that there too Stone Age settlements were focused on open, lightly wooded country in close proximity of water. Such localities would presumably have an abundance of water and both animal and plant food.[1]

There is every reason to believe that stone equipment of Early Stone Age man was highly expendable and that provided the raw material was available (as it usually was) tools were

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1. Butzer, K.W., Environment and Archaeology, 1964, p.364.

made on a particular occassion only/and were subsequently discarded when the band moved on. The nature of his subsistence required that man be fully mobile and it is unreasonable to suppose that large quantities of stone tools were carried about when man's technical ability enabled him easily to manufacture new tools. Naturally therefore sites having good supply of suitable stones would be preferable. River valleys usually have a good supply of pebble stones. In addition it must be mentioned that stone for making tools, which is very frequently found outcropping in such localities, does not there become dehydrated and is thus easy to work.[1]

In the light of the above it is not surprising that in India too the location of palaeolithic stations in river valleys - Soan in the northwest, Narmada, Korttalayar, Sabarmati, Burhablang, Penner, Maleprabha, Krishna, Godavari and their tributaries in peninsular India, suggest that settlements were generally located in broad river valleys and terraces which provided appropriate and necessary ecological set up for their mode of living as well as raw material for their tools.

Some of the most important centres of palaeolithic population were in the Potwar plateau in the northwest and in

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1. Howell, F.C. and Clarke, J.D.," Acheulian Hunter-gatherers of Sub-Saharan Africa", in African Ecology and Human Evolution, edited by Howell, F.C., and Bouliere, E., 1964, p.526.

the districts of Bellary, Chinglepu t, Nellore, Cuddapah, North Arcot, Guntur, Panjor and in the State of Karnatak in the south. Other important centres lay in Kathiawar, Gujarat, Central India, Chota-nagpur plateau and Orissa (especially in Mayurbhanj and Talchar).[1]

It is interesting to note that in the entire northern part of the country Stone Age man chose to live only in the elevated Potwar plateau. The absence of palaeolithic cultural material in the entire Indo-Gangetic plain is puzzling. It does seem that by choice the Stone Age man avoided the middle part of the country. It may be because of a not very suitable ecological setup for human occupance. It appear probable that in the post Tertiary period an arm of the sea extended up the Indus Valley as far as the salt lake and probably also up the Luni Valley.[2] Godbole is also of the opinion that Rajasthan was a sea as late as the time of the Indus civilizatio Much of the western part of the Indo-Gangetic plain was, therefore, not available for human colonization, atleast during the initial stage of the Stone Age. The same, to some extent, is also true of the Gangetic plain. Pascoe argues that the whole of the Ganga Valley was probably uninhabitable

1. Raza, M., "Human Ecology in Palaeolithic India", Geographer, Vol.XXI, No.1, 1974, p.58.
2. Oldham, R.D., A Manual of the Geology of India, p.430.
3. Sankalia, H.D., Indian Archaeology Today, 1962, p.68.

5000 years ago and that extension of human settlement eastward from the Punjab had been a slow and gradual process. The region 5000 years ago may have been so swampy as to be ill suited for colonization without being uninhabitable[1] and since the population was small, man was able to exist comfortable on the plateaus without having to colonize the less hospitable region to the east.

From the wider geographical point of view India during the early part of the Stone Age, occupied a lands- end position into which successive groups of Stone Age men entered from the west and probably had their first area of colonization in the elevated regions in the northwest which in turn might have served as a secondary centre of diffusion. The movement of the Stone Age men all over India appears to be rapid because the earliest archaeological horizons in every part of the country belong to the same age. (Fig.33).

The lack of appreciable concentration of tools in most of Indian Stone Age sites would indicate that the sites were mainly temporary camps in the seasonal movement round the hunting territory. If they had been occupied uninterruptedly for any length of time, some depth of deposit would

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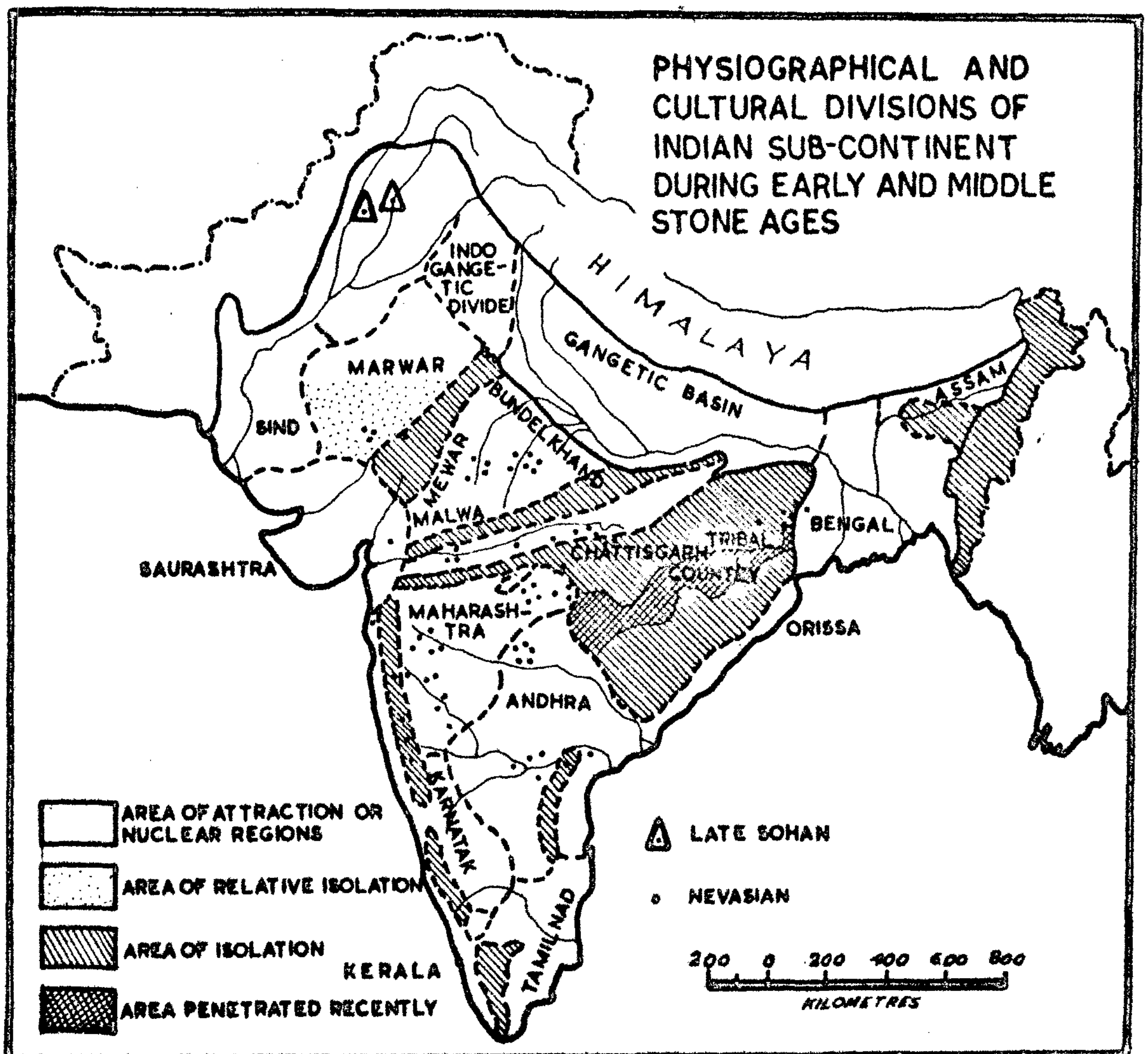
1. Pascoe, E.H., (Ed.) Manual of the Geology of India, Vol.III, 1933, p.1982.



After Sankalia

FIG. 33

be bound to have accumulated, inspite of the quicker dispersal of occupation debris that can be expected at open sites where there are no natural confines such as caves. Some of these sites can have been no more than stopping places for consuming some large food animal.

Prehistoric activities having some bearing of settlement system and their resultant archaeological expression can be classified as (a) resource extractive (example: gathering), (b) resource processing (example: removing fibre from leaves, grinding), (c) non-resource-dependent (example: sleeping, cremonial activity). The location where a particular type of prehistoric activity that left material traces took place can be referred to as an activity locus. Sites may be thought of as bundles of from one to many activity loci and the total of a prehistoric group's sites comprise its settlement system.

Settlement sites would be located so as to minimize the amount of time and energy expenditure in explorting, transporting and distributing critical food resources to the point where they are actually consumed. Among primary hunting-gathering people, there will generally be a single most critical resource (at any given time) the pursuit of which will be minimized by site location. It can reasonably be assumed that a correlation exists between site location and subsistence strategy at the palaeolithic stage and that infact location of site is functionally important to the maintenance of the subsistence procurement system.

So far we know little about the living places of the Stone Age man in India. This is quite understandable. All the present day primates live in warm regions and their mode of life requires no elaborate shelter. There is no reason to suppose that the situation was different during the Stone Age. Furthermore nomadic life requires purely temporary shelters. It is not surprising that no trace has been left. If fire was used the ashes of the temporary hearth were soon scattered by the wind. It can be safely postulated that the unspecialized Stone Age hunters- gatherers in India, as else where, had little need for shelter and lived in the open. Only during the colder glacial periods the use of shelter must have been made necessary in the periglacial and adjacent areas and caves and rock shelters, where they are found, must have been then used. Whether settlements were seasonally migratory or semi- permanent must have depended upon the habit of the principal herd animals of particular regions. Study of functional aspect of site distribution has not yet been undertaken in India but in Africa sites from where most stone tools have been discovered were butchery sites adjacent to good sources of raw material for making tools. More relicts remain at sites occupied for several days or weeks during which a number of animals were cut up, perhaps in conjunction with a seasonal harvest of vegetational food.

Demography

There appears to be two approaches to the study of population density and distribution of the Mid-Pleistocene hominids. First there is the direct approach through the study of the density and distribution of archaeological residue. Essentially this is an approach to the problem from the consideration of settlement pattern. It has been used effectively for short period and highly settled communities in limited geographical areas. It is more difficult to control all the variables when considering low density population of limited archaeological visibility through deep time. The second approach can be complementary in that it should provide the theoretical model for empirical testing. It envolves the use of analogues to the systematic organization of modern human population. This approach too has its drawback. Valuable as recent ethnographic studies on particular small social groups in kalahari have been, there has been distressing tendency to make inductive generalizations.

Unfortunately lack of visible archaeological density in India so far as the Stone Age is concerned make, scientific deductions about the demographic structure an extremely hazardous venture. However certain points can be made within the structure of currently available data:

(1) There appears to be an appreciable increase in the number of designated upper Acheulian and later tools relative to Early Stone Age tools.

(2) There was an avoidence of heavily forested swampy areas such as the Indo-Gangetic plain.

(3) The distribution cross cuts the broad ecological zonations excluding apparently only the dry deserts and tropical and sub-tropical forests.

The first point would suggest some increase in the population through time which would seem to stress the obvious. The question is whether the increase is to be viewed in terms of a linear increase in density through time or as a series of successively reached equilibrium levels. Population density depend on a number of factors including reproductive and mortality rates, despersal and competition etc. The archaeological evidence on site distribution primarily reflects dispersal.

We may never gain statistically sufficient samples for computation of the demographic structure but on physiological grounds a rate of greater than 5 per cent can be deemed unlikely but even at a slightly lower rate, population could double every quarter century.[1] It is clearly not possible to make a census of Pleistocene population but relative estimates is a possible aim. The relative frequencies of sites and tools suggest a significant difference between the Early and Middle- Late Palaeolithic.

De Vore[2] has offered an explanation for low densities for hunting- gathering foraging human population relative to other group living primates in man's need for hunting space. The estimate of 0.03 to 0.08 persons per square mile which he gives for hunters-gatherers in African Savanna is much lower than that for baboons in similar habitats.

In a study of Pleistocene population densities an analogy from recent populations of hunters-gatherers was used to estimate the population of S.Africa in terms of areas graded for environmental favourability for human occupation.[3]

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1. Wrigley,E.A.,<u>Models in Geography</u>, 1967, p.207.
2. De Vore, D.,"A Comparision of Ecology and Behaviour of monkeys and apes", in <u>Classification and Human Evolution</u>., Edited by S.L.Washburn, 1963, p.311.
3. Lee, R.B., "The Population Ecology of man in the early upper Pleistocene of S.Africa", <u>Proceedings Prehistoric Society</u>, Vol.29, 1963, pp.235-57.

When population density estimates are made in numerical terms, these assume that, as above, that population density level are comparable to present day population at a similar generalized subsistence level in comparable environment. A parallel assumption is that there was an analogous level of uniformity in dispersal pattern.

Stone Age hunters-gatherers suffered a continual struggle for existence- an ecological struggle engendered by demands for food, by climatic stress, by pathogens or by dangerous predators. Evidence from primate bands show that natural population tend to attain a viable density over a recognized territory without actual inter-territorial conflict or warfare. This density is infact a series of up and down fluctuations around an equilibrium value set by ecological circumstances and resources.

The densities attained throughout the Pleistocene everywhere remained uniformly low if we may judge from the meagre data at our disposal. A density of higher than one half square mile per head (2 persons per sqr.mile) was probably not achieved. For Britain in upper Palaeolithic a value of 200 square mile per head has been estimated comparable to that of the Eskimos. The densities for present day Australian aborigines is roughly 25 square miles per head. In the mesolithic densities were probably higher, about 10 sqr. miles per head.

So slow was the expansion of the pre-agricultural population and so generally low the density that it seems reasonable to assume that the population must have been subjected to control forces. These enabled them to keep in approximate equilibrium with the local food supply when ever further migration and splitting of families or bands became unpracticable owing to the occupancy of the surrounding areas. The existence of control forces must mean that pressure on resources and hence the forces of natural selection, were always at work.

For communities so exposed to the natural environment as the Stone Age hunters-gatherers, multiple natural control processes would operate as they do in the animal communities, with the addition of social measures. It is true we have little direct evidence of the way in which these different kinds of control actually operated to determine the population size, composition and longevity of different communities, of particular significance are the reported values for total fertility, that is the number of children per completed family. The most frequent figures of four children per mother for hunters gatherers seems lower than that for advanced agriculturists, with six or more. Of the four or five actually born in pre-agricultural societies, only two or three actually reach matuarity. The wide-spread occurrence of this small family size has been abundantly documented.[1]

The family as a whole tended to be small since survival beyond the age of forty was rare. For the slowing down the rate of reproduction a combination of biological and sociological factors would operate effectively in primilive society. As the expectancy of life is short the women's reproductive period is short, so also reducing fertility. Another factor is genetic, arising from the increased frequency of consanguinous marriages in small inbreeding groups.

Mortality rate and Life Expectancy

Mortality rate and life expectancy of Pleistocene population cannot be measured directly but it appears that the duration of life was much shorter than ours.[2] This assumption has been confirmed by Weiderneich,[3] Mc Cown and Sir Arthur Keith[4] and Senyurek.[5] This point is made clear by

1. Carr- Saunders, A.M., The Population Problem, 1922.
2. Vallois, H.V., "The evidence of skeletons", in Social Life of Early Man, (Ed.) S.L.Washburn, p.229.
3. Weiderneich, F.,"The Duration of Life of Fossil Man in China", Chinese Medical Journal, Vol.55, 1939, pp.34-44.
4. Mc Cown, T.D. & Sir Arthur Keith., The Stone Age of Mt. Carmel, Vol.2, 1939.
5. Senyurek, M., "A note on the duration of Life of the Ancient Inhabitants of Anotolia", Amer. Jour. of Phys. Anthrop, n.s.no.5, 1947, pp.55-56.

the following table.[1]

Table IX

Age of Fossil Man at Death

Name of Fossil Man	Age at the time of death (in years)							
	0-14	%	15-30	%	40-50	%	50-60	%
Sinanthropus (22)	15	68.2	3	13.6	3	13.6	1	4.6

	Age in years and age group at the time of death											
	Infant		Juvenile		Adult				Old Age			
Neanderthal (39)	0-11	%	12-20	%	21-30	%	31-40	%	41-50	%	51-60	%
	15	38.5	4	10.3	6	15.4	10	25.6	3	7.7	1	2.5
Upper Palaeolithic Europe (66)	29	38.2	12	16.0	5	20.0	11	14.7	7	9.2	2	2.8

From the above table it appears that infant mortality rate was very high, life expectancy was quite low and few individuals could hope to cross the age of forty. Another population sample of a prehistoric population is available and

1. Vallois, H.V. op.cit., p.223.

that also shows an infant mortality rate of 50 per cent below the age of two.[1] For the effective reduction of numbers in infancy the usual hazards of disease and malnutrition would ordinarily have been sufficient.

The sex ratio in population of palaeolithic hunters-gatherers was probably weighted in favour of men as is made clear by the following table:

Table X

Sex Ratio of Fossil Men[2]

		M	F
1.	Pithecanthropine	14	9
2.	Neanderthal and Pre-Neanderthal	18	11
3.	Upper Palaeolithic men of Eurasia	41	29
4.	Iberio-Mousterian of N. Africa	58	46

This sex ratio among fossil men population was probably because most women died young. In primitive societies

1. The Monillian population burried in the cave of Tofaralt in N.E.Morocco between 10,000 and 8,000 B.C. according to carbon 14 dating.
2. Vallois, H.V., op.cit., p.224.

particularly high risks are run by women during delivery under conditions of chronic food shortage, deficiency of calcium, iron and vitamens will all affect the female, specially during the vulnerable period of puberty and pregnancy. This will in turn affect their reproductive performance.

CHAPTER VII

SUBSISTENCE SYSTEM AND SOCIAL ORGANIZATION

Economy

Anthropologist Bohanman[1] defines economy as "the way in which resources, technology and work are combined to satisfy the material requirements of human beings and of social groups." It has long been recognised that even the simplest economies do not exist solely to take care of biological needs, such as food, shelter and clothing, but also to contribute to the satisfaction of social needs as determined by such consideration as kinship obligations, hospitality rules, or prestige requirements. It is infact impossible to comprehend fully an economic system without reference to the total culture of which it is a part, although for the sake of scientific analysis we can abstract those aspects of culture most concerned with economies, just as we can emphasize social organization, religion or art.[2]

Every economy functions within a physical environment which provides the resources utilized by the economy at the same time as it presents certain limitations within the system must be made to work. How these resources are used

1. Bohanman, P., Social Anthropology, 1963, p.31.
2. Gable, C., Analysis of Prehistoric Economic Pattern, 1967, p.1.

will depend upon technological abilities, choices made by the local group in terms of their own values, and the size and distribution of human population.

More than any thing else, archaeology adds a temporal dimension to the study of economic anthropology. Not only does it provide the means for describing the economic structure of specific prehistoric communities, it enables us to understand the long term development of economic behaviour from earliest hunter-gather up through the rise of the first urban civilizations. The emphasis on an economic approach to prehistory is not difficult to justify. Since of all the areas of human behaviour, it is economy that ties most closely with the technological and environmental data supplied directly by archaeological fieldwork. Further more the reciprocal influences of the economy and other aspects of culture on one another allow to make reasonable inferences about such things as social organization, political institutions religions or value systems. There are ofcourse some limitations for one can reconstruct prehistoric economies only on the basis of whatever material vestige of them happen to have been preserved. Most of the archaeological evidence pertaining to prehistoric economics must be indirectly derived from such facts as can be exhumed from the ground. This excavated evidence includes remnants of material culture, settlement features, food refuse, and natural historical indications of prehistoric environment, which was often rather different from that of the same area to-day.

The cultural evidence is largely of a technological order and may include tools, weapons, containers, hearth, storage pits, building foundations, fortification or irrigation system. From these one can obtaine some idea of how things were made, what raw material were used, whether goods were obtained by trade, what people did for a living, how they were clothed and sheltered, whether there was craft specialization and so on. Certain kinds of material remains- places, temples, graves, ritual objects and the like - take us more into the realms of social and ideological behaviour reflecting as they do attitudes toward the supernatural, concern with the after life and social control. But virtually all of these have economic overtones as well.

It must also be recognized that different types of archaeological sites yield somewhat different kinds of evidence- settlements, ceremonial centres, burial mounds, cemeteries, querries and butchery sites all tell us something, but the information from each is not of the same quality and character. Generally speaking it is the settlements of prehistoric people that contain most data of economic interest because they are not "special activity" sites and therefore present a wider view of daily life.

Collecting and analyzing the natural historical evidence, economic and environmental, acompanying the artifacts or structural features is absolutely essential to an understanding of cultural adaptation and utilization of resources. Particularly important are descriptions of prehistoric climates, flora and fauna; these descriptions must be obtained with cooperation of geologists, botanists, zoologists and other natural scientists who are appropriately equipped to handle such information. Unless an archaeologist is fortunate enough to have these specialists working in the field with him, he must collect the necessary data himself inorder that the natural scientists can later evaluate them in the laboratory.[1]

Apart from functional tool interpretation, archaeologica evidence on economies is largely confined to analysis of biological remains and refuse. In the case non-agricultural groups such analysis includes:

(a) Composition of the faunal remains as to orders and species, giving evidence as to the range of ecologic niches exploited;

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1. Gabel, C., Analysis of Pre-Historic Economic Pattern, 1967, p.8.

(b) Indications of possible selectivity of species, suggesting deliberate choice, particular hunting methods, seasonal availability of certain species, etc.;

(c) Age and sex composition of the fauna, giving further information on hunting techniques and seasonal activities;

(d) Disposition of faunal remains in a site, providing evidence of human behavioral patterns, methods of butchery, etc.;

(e) Determination and over all interpretation of any vegetable remains.[1]

Economically throughout the palaeolithic period people were almost entirely dependent upon hunting and gathering in one form or the other. It was a parasite economy when man exclusively depended upon the bounty of nature. Food production was unknown. Pending discoveries of actual palaeolithic habitation sites yielding the requisite evidences that would enable us to ascertain the basic elements in the economic setup, on theoretical ground we can visualize for the Early and Late Stone Ages respectively the

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1. Butzer, K.W., Environment and Archaeology, 1964, p.340.

following economic setup.[1]

1. Unspecialized Food- Collecting,

a) Naturally determined mammalian subsistence and free wandering (this should not indicate areally unlimited wandering but rather shifting ephemeral settlements of a few days duration within limited territories) with tools fashioned but not yet standardized. This is thought to include the Australopithecine and the very crude and typologically variable early pebble tools.

b) Food-gatherings, with free-wandering, hunting and the earliest standardized tool-making traditions. Subsistence patterns are significantly determined culturally. Tools of the early standardized traditions of core biface, flakes and choppers appear with broad distribution for a given tool type.

c) Food-gathering with elementally restricted wandering, hunting and some variety in standardized tool forms within regions.

2. Specialized Hunters- Gatherers,

d) Food-collecting, with selective hunting and seasonal collecting pattern for restricted wandering groups. Considerable

1. Braid Wood, R.J., "Levels in Prehistory: a model for consideration of evidence", In S.Tax (ed) Evolution after Darwin, Vol.2,pp.143-51.

typological variety with rather marked regional restriction of any given industry.

e) Food-collecting with intensified hunting and collecting with seasonally different activity by restricted-wandering or centre-based wandering groups. Beginning of plant manipulation.[1]

In the scheme outlined above the subsistence pattern of hunter-gatherers would be determined by life-support resources available to the community. The life support resources of a group are defined by the characteristic of the natural environment (what is available in the way of raw material); the technology at the disposal of the group, its organization and exploitive activities and the presence or absence of intergroup competition. The inventory of resources may change with a change in any of these factors. Key life-support resources which might be applicable in general terms to most of the palaeolithic groups can be enumerated as follows:

1. Hunting.Key resources:

a) Water resources habitually frequented by megafauna,

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1. Butzer, K.W., Environment and Archaeology, 1964,p.341.

b) Grassland areas capable of supporting large population of various megafauna.

2. Collecting or intensive foraging. Key resources:

a) A highly diverse biotic community (i.e., a wide variety of fauna and flora),

b) Concentration of this biotic diversity within a limited geographical area.

Reconstructing the resource inventory of a prehistoric community at a given time presents some knotty problems because it requires that both the present and the past environment and past cultural adaptations to it be restructured in some detail. As noted earlier the resources of a group are defined not only by the availability of the material from the natural environment but also by the group's technology, its organization of resource related activities and its relationship to neighbouring groups. The present distribution of many environmental characteristics can be assumed to bear a fairly strong resemblance to the past distribution of these characteristics. Ethnography can also provide valuable analogues for the kind of resources used and adaptative capacity that we may expect people in these areas to have displayed. Furthermore ethnographic data will be of some help in constructing models of resource-use activity and organizational pattern.

Determination of the basis of subsistence from archaeological material is an other possibility. We can excavate the remains of food as well as the tools used to obtain it and make quite specific and quantitative statements of who was eating what and when. It should however, be borne in mind that there is a peculiar difference between the evidence of hunting and the evidence of gathering interms of what is preserved. Bones and stones are the normal material which survive from the palaeolithic. These materials also form the bulk of evidence of game pursuit at the time; they give us a clear picture of hunting activities and technology. If ethnographic evidences are to be relied upon, the tools used in gathering and the plant food gathered, are quite perishable. In view of recently gained understanding of the ratio between hunting and gathering in the subsistence base of living hunters, the role of hunting during the palaeolithic might be over emphasized.

There is a marked variability among the Middle-Pleistocene assemblages of artifacts. The interpretation of the diversity of tool kit has proved very controversial.

The principal axis of variation which has been perceived by most workers, concern the relative proportion of large Acheulian tools, such as handaxes and cleavers, to small scrapers, awls and other forms which are not specifically Acheulian. The observed range of proportion of the biface, for instance extends from 0 to over 80 per cent. It has as yet proved impossible to demonstrate any clear time or space correlates for the two poles of this variable. This constitute an anamoly in as much the observation deviates from the expectation of linear evolution which arose in the early days of palaeolithic archaeology differences in activities have been advanced as a line of explanation: that it is argued that different tool kits are appropriate in different situations and that, therefore cultural system can be expected to generate a wide diversity of assemblages. Since there would be long term continuity in such basic activities as butchering carcasses or gathering plant food, the spectrum of variation can be expected to persist and to lack correlation with time or microgeography.

The most definite suggestion made in this regard is that small scrapers and other small tools are much more likely to be found in association with butchering large animals than are bifaces and other large cutting tools.[1] It has been suggested that handaxes, bifacial knives etc. may have been preferentially associated with sites where butchery and meat consumption were not important.[2] Handaxes are serviceable for cutting and splitting, for taking bark and for adzing, digging, powding, but they are not very suitable for killing game. It has been suggested that the makers of core tools were wood-land dwelling collectors and those of flake industries were ancestors to hunting societies. This hypothesis could help to account for the rarity of handaxes from areas north of the Alps, Caucasus and the Himalayas. The hypothesis, however remains to be tested and at any rate, there no clear cut tool dichotomy characterizes Indian palaeolithic.

In India, during Pleistocene period, the ecological situation provided full scope for the development of hunting-gathering culture. There are sufficient palaeontological evidence[3] to suggest that during the wetter phases, the wide

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1. Clarke, J.D. and Harynes., "An Elephant butchery site at Mwangandas Village Karonga, Malawi and its relevance for palaeolithic archaeology, World Archaeology, 1969, Vol.I,pp.390-441.
2. Binford, L.R.,"Contemporary model building: Paradiguns and current state of palaeolithic research", in Models in Archaeology, (edit.) D.L.Clarke, 1972, pp.109-166.
3. De Terra, H. and Paterson, T.T., Studies on the Ice Age in India and Associated Human Cultures, 1939, p.341.

flood plains were sufficiently covered with vegetation, not only to provide a base for the gathering economy but also to allow abundant grazing for horses, buffaloes and other bovidys in whose pursuit early man must have roamed over large areas. Even during interpluvial periods archaeological evidences show that the habitat still must have offered suitable ecological conditions to the palaeolithic hunters who settled temporarily but repeatedly over the same area.

Much has been written about early man in the Pleistocene as hunter-gatherer. The more we learn about these hunter-gatherers within the 500,000 - 50,000,00 year time range, the more diverse the hunting behaviour appears to be. During the earliest stage slow-moving and easily captured animals would have been more important. It is only from the Upper Palaeolithic that hunting cultures are clearly known. The Middle Palaeolithic has uncertain indications of specialization, as in the mousterian points. The longer Lower Palaeolithic has yielded only artifacts of kind that may have served for many uses. From all this varied data we have to derive some idea about man's economic activities in the distant past. While this can be done, it seems that generalizations about the entire Pleistocene concerning hominid extractive efficiency, distribution and ecological adaptation, in the present satate of our knowledge, is highly premature.

To what extent the Indian Ice Age filled into this general frame-work, we have no direct means of ascertaining. To begin with, during the Boulder Conglomerate stage of the upper Siwalik (IInd glacial-pluvial) when man first makes his appearance, the wide flood plains were sufficiently covered with vegetation to allow abundant grazing for horses and buffaloes. In their persuit early man roamed over large territories, leaving meagre yet unmistakable evidences of his activities. The crude and primitive pre- Soan tools of the period bear witness to his undeveloped intelligence and to the geographic limitations of his habitat , as determined by river banks and the grazing grounds of the east, survivors of the rich Siwalik fauna.

During the succeeding T_1 period (IInd Interglacial) the climate became drier than previously and archaeological sites suggest that people settled temporarily but repeatedly and over long periods in the area. The habitat still must have offered sufficiently attractive conditions to the Pleistocene hunters of buffaloes, straight tusked elephants and hippopotamus. We may thus visualize a small ice age population living in tiny groups of families or small tribes following the animals they killed for food over great tracts of the country. It was impermanent, precarious and isolated.[1]

Initially the economy of the Late Stone Age cultures must have been based primarily upon hunting and gathering. Actual hunting methods were probably more efficient than those of earlier times. Late Stone Age tools take over from those of the Middle Stone Age in all the drier parts of western and central India, and in much of the peninsula, with a completeness that suggests that they represented a marked improvement. But in region of higher rainfall and in the extreme south, continuity of Middle Stone Age techniques suggests a some-what different state of affairs. Late Stone Age coastal sites both on the West coast and in Madras show by their situation, and by modern analogy, that fishing must have formed an important, if not a staple part of the economy of the people who used them: they are chosen for proximity to the coast and to lagoons and inlets rather than for access to good hunting grounds. For the inland people of the Late Stone Age in areas of moderate and low rainfall hunting must have taken on a greater importance, as new methods meant that it could provide a higher proportion of

1. Piggot, S., Prehistoric India to 1000 B.C., 1962, p.24.

their food, thus swinging the balance away from the collection of vegetable foods which must have continued to be of primary importance in regions of higher rainfall. The presence of bones of both wild and domestic animals at Langhnaj and Adamgarh sites suggest that the economy of the hunters was augmented by pastoralism, or perhaps by trading with settled neighbours or prey upon their herds. The bones identified include cattle, pig and buffalo at both sites, and sheep and goat at Adamgarh only, along with several species of deer and smaller wild animals. Birhanpur and other sites on the other hand give no indication of anything except hunting and gathering.[1]

Diet and Nutrition

The contemporary anthrapoids are essentially adapted to a forest ecology, subsisting largely on fruits, leaves and insects. All known races of man, on the other hand include a substantial proportion of meat in their diet. It is not plausible that early man had changed abruptly from a vegetable diet to a mostly meat diet. Like all other primates, early man must have lived on whatever food he could procure. After the abandonment of arboreal living and venture into

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1. Bridget and Allchin, R., The Birth of Indian Civilization, 1968, pp.255-256.

open country, he found fewer edible plants but more small and slow moving animals with which to supplement his diet. The first humans were indiscriminate gatherers of all kind of plants. Only after the mastery of lithic techniques could man add large animals whereever their ecological setting made this necessary. It was thus that the diet of protoman became more varied as they changed from being largely plants eaters to being in part meat eaters. It has been shown that baboons inhabiting savannah regions become increasingly flesh eating as a result of the intensification of the struggle for existence at times of environmental stresses such as draught. It has been suggested that early hominidae too might have taken to flesh eating in times of scarcity of food. Anyway by the time the hominidae had evolved into tool makers, they were evidently carnivorous. We have ample evidence of this in the cultural remains left behind by Peking man, Neanderthal man and Late palaeolithic races of Homo sapiens.

Man's departure from general anthrapoid dietary pattern was not an absolute one but one of degree. The use of plants, fruits, nuts, berries and roots continued, but the use of meat became greatly intensified. The hominid diet was now such that it could provide within very wide limits calories and proteins in adequate amount for growth and activity.

It appears that in the dietary pattern mentioned above, the food intake of the hunter-gatherers would be high in animal protein and fat and low in carbohydrate. But at the same time food intake must be high in order to ensure adequate energy intake. A hunter's daily diet might be composed of 400 grams of proteins, 150 grams of fat, 60 grams of carbohydrate, giving 1600, 1350, 240 K cals of energy respectively to make a total of 3190 K cals.[1] Efficient and rational utilization of the resource base might have provided this amount of food during normal times. But a hunting gathering population can not always hope to have access to a regular food supply. Fluctuations in the availability of food supply is inherent in the very nature of Pleistocene ecology. All modern hunting population is faced with this irregular pattern of food availability, leading to irregular pattern of food consumption- high at periods of availability and low when food was not plentiful. As storage of food was unknown during the Stone Age, people might have been tempted to over eat when plentiful supplies were available.

As stated above, wild vegetables also must have been an important source of food. The fruits and shoots are best found in the fringe of forest and along the water courses.

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1. Weiner, J.S., The Natural History of Man, 1971, p.121.

They can be collected with little more than a chopper. Honey may have provided the necessary sugar and deficiencies in mineral salts could be supplied by some lake or river salt. Thus we may presume a reasonably balanced diet for these hunters.

Social Structure

Social groups through the long periods of the Early and Middle Palaeolithic period, probably consisted of little more than extended families living by hunting and gathering in their own loosely defined territories. With the Late Stone Age we see indications of what is probably a wider network of social contacts reflected in the large factory sites and the rock shelters with paintings which illustrate a varied range of activities and concepts. A few factory sites such as Kondapur in the Deccan, or some of those in the Narmada Valley in central India for example, the frequent occurrence of stone tools in gravels of the most of the major rivers, and their remarkable absence from cave deposits, all indicate a nomadic life in the open, centring upon the banks of the great rivers and the better watered parts of the country. The considerable size of certain of these Middle Palaeolithic factory sites suggests continunity of population and local tradition over a considerable period of time, as indeed does the material from Sanghao.[1]

Large factory sites of the Late Stone Age are also found in certain region, notably in central India and north Karnataka etc. and corresponding sites of the Middle Stone Age suggest continuity of local tradition. potholes noticed at Birbhanpur in the extreme eastern extension of the central Indian hills strongly suggest that people began to inhabit caves and rock shelters regularly.

Essentially living sites are in the proximity of water and land suitable for hunting, or other essential activities. At different periods other factors, such as a view of the surrounding countryside, freedom from insects, accessibility, defence and communication may take on increasing importance. Factory sites, or for that matter the site of any special activity, are oviously selected for different but related reasons. The size of the settlement is characteristically one of the small group settlement with anywhere from 4 to 20 families and 20 to 100 people. Each individual family occupies one shelter. As community effort is vital, dispersed settlement is unusual. As social organization is

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1. Bridget & Allchin, R., The Birth of Indian Civilization, 1968, pp.233-234.

not rigid, individual families may leave one hand and join another, so that the size of shifting settlement is rather variable.[1]

The population growth depends primarily upon fertility. It appears that fertility in man always was adequate for possible population growth which if lacking, must have been prevented by a death rate equal to or surpassing the birth rate. It seems that pain and suffering has existed throughout human evolution, merely varying in prevalence now and then according to racial immunity, environmental conditions, or dietary habits and so in early times the expectation of life was short, marriage took place at an early age, and the generations followed one another rapidly. Only one population sample of prehistoric period is available to us in regard to the structure of population (The Monillian population buried in the cave of Taforatt, in N.E.Morocco, between about 10,000 and 80,000 B.C. according to carbon 14 dating). This isolated population survived almost 50 generations during which there are no evidences of a cultural change. No morphological change may have taken place either. There was an infant mortality of 50 per cent below the age of two.[2]

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1. Butzer, K.W., Environment and Archaeology, 1964, p.344.
2. Coon, C.S., The living races of man, p.33.

The absence of palaeolithic habitation sites similar to those found in Africa and Europe makes it very difficult to make conjectures about the social life of these early inhabitants of India.

What has been said in earlier cahpters clearly shows that the palaeolithic people of India had a well characterized culture, well adapted to their mode of living and economy. Now all forms of cultural behaviour are based on some system of social action. Social system are not even unique to man. They also occur in infrahuman primates where they constitute generic and characteristic modes of adaptation. Therefore, we may even postulate that social life long antedated any form of cultural superstructure which among hominids eventually developed into an organized system of social action.

Some sort of division of labour between the sexes can be visualized. The task of collecting and gathering was of women while men hunted. The result of the labour of both must be carried back to some agreed upon location. Meat can be carried away easily, but the development of some sort of receptacle for carrying vegetable products may have been one of the most important advances in human evolution. Without the means of carrying, the advantage of a large area are greatly reduced and food sharing implies that a person carries much more that he consumes. Archaeological evidences suggest movement over large ranges, suggesting cooperation and sharing-some of the most important aspects of human behaviour.

Richard Lee has argued that containers are basic human technological inventions since division of labour and the sharing of gathered vegetable food depends on portable baskets or sacks. Observations of primates in the wild make it clear that they are simply unable to carry any appreciable quantity of food about and that this limitation is often inconvenient to them. This draws attention to another point of evolutionary significance: namely that meat is naturally containerized and readily transportable, and is very likely to have been the first commodity to be shared on an economically important scale. Sharing of meat can already be inferred by 1.8 million years ago at Olduvai. Whether or not the gathering of plant food in containers and its sharing was a part of the behavioral organization at this early time remains to be determined.

The palaeolithic economy was totally incompatible with sedentary living. Bands of hunters-gatherers are by necessity nomadic and must be constantly on the move to sustain themselves. But a certain amount of territoriality can be postulated on the assumption that food can be more efficiently secured if the area-the terrain and the seasonal rhythm of the biotic world- is thoroughly known. Territoriality is one of the most important features of the adaptation of the infra-human primates among whom the locus of the social structure is a bounded area defined by the spatial range of the daily activities of the members of the group. Ecologically territoriality is the means by which the dispersal of the total population of a given region is spatially ordered and the independence of the inbreeding groups is maintained as a distinguishable social unit. Ordinarily members of the different groups in a given region do not freely mix. The strong avoidance behaviour that prevails between different groups is complimented by the factors that promotes in-group integration. Territoriality, therefore, is a fundamental ecological adaptation that, at the same time, functions as a barrier to social integration at a higher order and to more complex social composition and role differentiation.

If territoriality was a feature, as it seems very likely, of the palaeolithic social organizations, some interesting questions arise. What was the size and range of these groups and at what point in hominid evolution and under what conditions were groups of a higher order of complexity formed. At this level, as already explained, sexual differentiation of role in the performance of economic task has emerged. We can only assume that in course of time factors must have come into play that made possible the functional integration of groups with radically different social composition and role differentiation from those that existed at the earlier stage of hominid development.

Territoriality among hunters and gathers is seldom exclusive and group members are apt to change and shift according to the availability of food resources in space and time. Most of the primitive people at the hunting-gathering level of subsistence known to ethnography do possess strictly defined hunting-gathering territories, though the size of such territories varies greatly according to local ecological conditions. Among the Australians it varies from 200 to 5000 sqr. miles,[1] for the Northern Algonqnian's a figure of 64 to 1716 sqr. miles has been given. Since the existence of analogous territorial boundaries have been known for several diverse genera of mammals, it has been suggested that the same

1. Davidson, D.S., "An Ethnographic Map of Australia", Proc. Amer. Phil. Soc. Vol.79, 1938, pp.649-79.

must have been true for palaeolithic man. Such generalization may not be taken for granted. For instance many hunting people (specially pygmies of Congo-Camaroon area) do not have well defined territories. Also fixed territory implies stable ecological setup which might have not been there during the unstable environmental conditions of the Pleistocene. Therefore we cannot be certain, in the present state of our knowledge, that palaeolithic groups were territorial unit. All that we can say is that they were capable of large migrations.

At the earliest cultural stage, the size, composition, structure and behaviour range of social groups was determined by the same basic factor of ecological adaptation, generally characteristic of non-human primates. The acquisition of hunting habits must have been accompanied by a great enlargement of territory, since the source of food was now more erratic and mobile.

Of all the aspects of the behaviour of early man for which archaeology might be called upon to provide answers, group size and organization during the Stone Age is one for which data is at present least readily available. But ethnographical evidences may throw some light on this problem. The investigations made of modern hunting population which have collecting as a necessary supplement show that they are never more than a very small number of families. Davidson[1] estimated that among the Australians the band consists of about 35 individuals.

Similarly it was found that the hunting groups of North Algonqnians[2] in the vicinity of northern Lake Victoria region varied from 2 to 17 persons with an average of 5.6, the group in the Baren river region varied from 4 to 49 with a mean of 14.9. For the Bushmen it has been noted that the density of the group rarely exceeded the number of individuals who can live off the body of an antelope.[3] Similarly the hunting group of pygmies of Congo who still have retained their primitive way of life do not normally number more than 10 adults. As far as may be inferred from the burials of Neanderthal and upper Palaeolithic men of Europe, except for unusual case, it is evident that men of this period must have been divided into small groups of from 10 to 30 individuals, as hunters are today. Schapera gives the figure of 20-30 persons for the Bergadana.[4] A study of these primitive people

1. Ibid.
2. Hallowell, A.L., "The Size of the Algonkian Hunting Territories: A Function Ecological Adjustment", American Anthropologist, Vol.51, 1949, pp.37-45.
3. Black, D.F., Rock Paintings in S.Africa from parts of Eastern Province and Orange Free State, 1930.
4. Schapera, D., Government and Politics in Tribal Societies, 1856.

at a comparative economic stage shows that socially palaeolithic hunting groups could not have been madeup of a large number of families.

In the palaeolithic hunting groups, which could not have been large, the proportion of adults males, as already explained, was higher due to the early death of females during pregnancy. This fact surely must have influenced social organization too. The band probably was composed of more children than adults. As pointed by Vallois[1] a number of other conclusions may be drawn concerning the structure of prehistoric social group: (a) as most of the people died before attaining the age of 40, the social group did not contain many old people in our sense of the term, and (b) lack of contact between successive generations as life expectancy was only 40 in the case of men and 30 in the case of women. This means that by the time the elder children grew up, the mother is probably dead and the father nearing his end. Under such conditions education and care of the youngest born must have often been passed over to kinsmen.

As occupation spread into ecologically marginal areas, increased mobility might have been called for. Men,

1. Vallois, H.V., "The evidence of Skeleton", in Social Life of Early Man, (Ed.) Washburn, S.L., pp.223-224.

therefore, would have become the principal provider of food, the scout and trail maker and leaders of the group on the march from one camp to another. Thus arose, we may infer, the primacy of the male which has become a rooted element in human social structure.

The women were the mistress of the hearth. They learned most about plants and their uses. As they learned to cook, new food potentials were discovered. Man's ability to digest raw food is limited. Women experimented with roots, stems and fruit at the hearth and learned to identify in the field which one could or could not be made palatable. Women were the food chemist and botanist of the group.

It is reasonable to suppose that there was no member of the group who were not engaged in subsistence activities. Therefore there must have been some means of controlling behaviour and ensuring cooperation among individuals. Even at this early stage cooperative effort must have been essential for survival. It might not be over-stretching the evidence, therefore, to suggest that some sort loose tribal groupings were already present by the Middle palaeolithic period. And that as with improved technical ability permiting greater exploitation of the resources of the environment there would have been an over all increase in the size of the hunting band, calling for tighter and much more elaborate social organization.

During Early and Middle Palaeolithic period, social groups probably, therefore, consisted of extended families under some sort of tribal system in loosely defined territories. In the Late Stone Age we see probably indications of a wider network of social contacts, reflected in large factory sites and rock shelters with paintings which illustrate a varied range of activities and concepts.

Most of the palaeolithic assemblages of the tropical India suggests that settlement was focused in open or lightly wooded country, in close proximity to rivers, lakes or the seashore, such localities would presumbly supply an abundance of water for both animal and plant foods. Raw material for tool making is present in most areas, and the tools used for animal dissection were apparently made to order on the spot.

Apparent living sites of the Lower Palaeolithic take the form of lithic tool and bone concentrations recording both the tool making and meat eating activities of man. Some parts of such "cultural floors" were primarily used for tool-flaking, others for the dismemberment and efficient use of animal game for food. Various foci of archaeological concentration may suggest that a band reoccupied a site on several occasions, or also that several groups may have temporarily occupied it together. In either case the lack of appreciable thickness to such cultural floors seems to indicate that sites were only emphemeral camps, possibly in a seasonal movement within a hunting territory.[1] Some of these sites can have been no more than stopping places for consuming a single large food animal. Others however, provide signs of deliberate and more prolonged occupation and are believed to represent butchery sites where a number of animals, on more than one occasion were killed, cut up and eaten, or where a seasonal crop of vegetable foods determined a stag of several days. The considerable size of certain of these sites suggest continuity of population and local tradition over a considerable period of time. Large factory sites of Late Stone Age are also found in certain regions, notably Central India and North Karnataka and corresponding sites of Middle Stone Age also suggest continuity of local traditions.

From the increased tool- making ability, it can be assumed that Middle Stone Age man's intellect had developed considerably beyond that of his predecessors and the fossil

1. Butzer, K.W., Environment and Archaeology, 1964, p.364.

record shows that by the later half of the period, Homo sapiens had replaced the palaeonthropic stock. There is indirect evidence that social structure was more complex than in Early Stone Age. It can, therefore, be presumed that man was able to communicate ideas to his fellow men in a way that is only possible by the aid of some system of communication.

It is not yet certain that articulate language as such had taken shape in these early human groups but some lower form of language is inseparable from the lower human thought at this stage. Oakley and others have suggested that early hominids may have depended primarily on gestures, mainly of mouth and hands accompained by sounds and cries to attract attention and that speech may have been a comparatively late development,[1] so a non-hominid mode of communication would have persisted at the proto-cultural stage. It must however be stated that Oakley's hypothesis must remain speculative as it is difficult to imagine how a fully developed cultural mode of adaptation could operate without speech. It is more reasonable to suppose that there existed at least a sublinguistic code at the protocultural level, giving rise to true speech and articulate language towards Late Stone Age.

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1. Oakley, K.P., "A Definition of Man", Science News, No.20, 1951, p.75.

What has been briefly stated above suffice to illustrate that men of the Stone Age were no brutes but possessed a full range of social behaviour which differed radically from other non-hominid primates. Some important features of social behaviour and structure can be assumed to be:

(1) regular and systematic hunting based upon organized cooperation,

(2) sharing of food with in families or communities,

(3) Operation from well difined operation bases,

(4) dependence upon manufactured tools,

(5) extensive division of labour between sexes,

(6) the existence of family units based probably upon mating bonds,

(7) the use of some sort of language and

(8) the regulation of behaviour and complex role system collectively called culture.

While the first four features can be archaeologically documented, inferences regarding the latter features are generally indirect and depend on in sight into functional interrelationship among classes of behaviour that can be documented.

The probable features of the social life of the Pleistocence Man can be summarized and tabulated as follows:

TABLE XI

Probable Features of Social Life of Pleistocene Man

Period		Habitat	Habit	Group Size	Group Structure	Posture Body Size and Mother-Child Relationship
Upper and Middle Pleistocene	Australopithecus, Homo	Open Savannah taiga and steppe	Hunting	Tool specialization increases productivity through hunting, and	Possibility of large group structure arose again	Upright posture present. Mother-Child relation changed. Mother required to hold and care for feeding child.
Lower Palaeolithic 1 Million years		Parkland and more movement into the open Savannah	Expansion of brain, making possible adoption of cultural adaptation	Relatively large aggregations were possible but became smaller as body size increased	Group size diminished and became dependent more and more frequently on a greater number of other factors than hierarchial order between males	
Pliocene 12 Million years	Pre-hominids	Parkland with increasing excursion into open country	"Act Complexes" were gradually dissociated from their emotive background and became available as exploratory movement. The act complexes themselve broke up so that the component movements are now separately available for exploratory behaviour.	20 - 200 individuals aggregate into large hordes at specific points (e.g. water sources)	Groups arranged around a hierarchial core of males	Posture became upright.
Miocene		Forest	Little diversity of exploratory behaviour in new situation because different movements were bound together in rigid, act complexes, evoked only under specific motivation.	Model group 20 - 30 individual		Child still activly clungs to mother.

After Bergounioux

EPILOGUE

Writing something by way of an epilogue about a period regarding which our positive knowledge is so limited would seem to be premature. But from what has been said a few remarks pertinent to the general theme can be made.

Man as an artificer and bearer of culture emerged in the middle of the Pleistocene in India during the second glacial phase of the Ice Age. So far no human fossils dating back to the Pleistocene have been discovered in India but his cultural remains are considerable and wide spread. So far the earliest artifactnal evidence of Man in India comes from the Boulder conglomerate stage of the Upper Siwalik in N.W.India and perhaps from corresponding basal gravel stage in peninsular India and elsewhere during the second Himalayan glaciation. It is however likely that Man was present in the subcontinent at an earlier phase.

The prehistory of Man has been divided by the archaeologists into three main stages - the Stone Age, which was of immense duration and the relatively short Bronze and Iron Age. The Stone Age is further sub-divided into three main periods - the Palaeolithic, Mesolithic and Neolithic.

The Palaeolithic period coincides with the Pleistocene and broadly represents the earliest stage or the stage of hunting, fishing and food gathering economy. Within the chronological framework of the Pleistocene, the Palaeolithic or the Old Stone Age is divided into Early, Middle and Late Stone Ages, of unequal duration and sharply contrasted cultures.

The culture of the Old Stone Age in India has survived only in the forms of stone tools. But stone tools are not merely a human artifacts. They are the durable material expression of an extinct people's adjustment to its environment which enabled it to survive and develop, manifestations of a technological tradition within a socio-economic system which is adapted to an environment.

To the archaeologists prehistoric cultures have definite connotations. It is mainly material culture that archaeological relics reveal and therefore it can be defined only in terms of archaeological visibility. To the archaeologist culture is an assemblage of associated traits that recur repeatedly.

In the Palaeolithic period, therefore, cultural traits are essentially technological and typological. The Early Stone Age record in India reveals distinct assemblages of stone artifacts showing several characteristic techniques of manufacture. Artifacts occuring in close association and related by one or more techniques constitute an industry.

The Early Stone Age of India reveals several techniques and tool complexes but their spatial and vertical distribution is as yet not fully understood. Broadly speaking three distinct lithic traditions can be recognized in India's Lower Palaeolithic: i) A biface core- tool tradition termed Abbevillian-Acheulian; ii) a pebble- tool tradition and iii) a flake tradition coupled with pebble tools. Vertical division between these traditions are not always discernable since all the three appear as integral component of a single cultural complex. For this reason, the parallel phyla concept, which has been applied to European Old Stone Age culture is in applicable to the Lower Palaeolithic cultures of India.

The core-tool tradition in India has its main concentration in peninsular India, especially round Madras where it makes its first appearance in the Boulder conglomerate and show remarkable development in the succeeding laterite phase and terrace stages. The biface industry is characterized by a great variety of forms and several stages of handaxe development. These handaxes and cleavers resemble greatly similar tool of Upper and Late Acheulian in north. The second terrace stage at Madras clearly shows the application of core- flake technique. Similar bifaces also occur in inland Tamil Nadu, Andhra and Bombay, northward in the Narmada Valley, eastward in Manbhum- Singhbhum and Son-Rihand region. The predominance of the biface, however, diminish northward and westward.

On the whole it appears that a dominant core- tool tradition with biface and cleaver as its main elements is spread over larger parts of peninsular India. A similar core-tool tradition also prevails in Africa and Western Europe. The European distribution of biface, however, in the Abbevillio- Acheulian tradition is a small marginal extension from original centre in Asia or Africa. The southern origin of the handaxe cultures seems to be taken for granted. It may be pointed out here that the African Stellenbosch-Fauresmith and the Indian biface and cleaver (Madrasian) show great similarity in lithic techniques and tool kits.

The Indian and European core-tool traditions reveal some interesting comparisions. The appearance of the Acheulian biface can be dated in northern India as well as Europe to the second interglacial. But in the Madras region the Acheulian biface seems to be a bit earlier - a climatic phase similar to the second glaciation. The Levalloisean technique appears in north India (Late Soan) and Western Europe at about the same time-during the third glaciation. Similarly the Clactonian technique, recognized in the Early Soan appears at about the same period in Western Europe - second interglacial.

So far as Africa is concerned, the Abbevillio-Acheulian development in the two regions is broadly similar. The handaxe - cleaver development in both the regions shows remarkable similarities. The handaxe and cleaver on flake, however appear in India at a later stage than in Africa.

The chopper- chopping tools - another distinctly characteristic feature of Lower Palaeolithic cultural complex of India-are generally found associated with the biface in peninsular India. In north in the Punjab, on the other hand, they are free of the biface and occure as an integral part of the Soan complex. As yet no horizon containing pebble-tools exclusively has been discovered in India like the Olduvan Bed I. Both the Early and Late Soan show characteristic flake techniques coupled with the constant use of pebble tools. It may be pointed that pebble-tools appear earlier in peninsular India than in the Punjab. The Upper Siwalik Boulder Conglomerate, which is the earliest tool horizon in the Punjab

(Pre-Soan) has not revealed any pebble-tool nor any biface, where as a Boulder conglomerate horizon in Madras and Mayurbhanj, which appear to be corresponding deposits, reveal presence of the pebble-tools along with biface core-tools and associated flakes.

Outside India, pebble-tools, similar to those the Soan and free of the biface occur in the Anyathian of Burma and Chokoutienen of China and the Kafuan-Olduvan in Africa. According to Leakey, the simple pebble-tools of the Olduvan, which constitute the earliest lithic industry in Olduvai, have evolved into the biface handaxe in the succeeding beds. In peninsular India, the occurrence of crude proto-types of handaxes on pebbles reminiscent of Olduvai Bed II is typologically also suggestive of a transitional stage.

According to Movius the chopper-chopping tools not only formed a basic lithic complex in India but also constituted a sort of basic sub-stratum in a region extending from Europe to Africa and South-East Asia, and that they became of secondary importance with the development and refinement of the handaxe. The tradition, however, according to him persisted and continued to develop independently of the biface in S.E.Asia, N.India and China as a distinct part of the Early Stone Age cultures. So far as India is concerned two distinct trends of the occurrence and development of pebble-tools can be observed. In the South, they seem to appear earlier as a basic complex of the biface tradition and show a continuity with a subsequent obsorption by the biface. In the North, pebble-tools appear free of the biface and integrally associated with Clacto-Levalloisean techniques. They show a vertical continuity and progressive development along with the development of the flake tradition.

The flake culture of India was mainly concentrated in the Punjab, where it is known as the Soan and which is generally free of the biface. The biface which is present as a distinct complex alongside Early Soan, generally disappear from the Late Soan.

The Soan is essentially a tradition of pebble and flake tools free of the biface like the Anyathian of Burma and Chokoutienen of China and range in age from second interglacial to third interglacial. The peculiarity of the Soan culture as a whole in contrast to other contemporary cultures of India is that it carries three lithic traits in integral association- pebble tools, pebble-cores and flakes and that with rare exception it is generally free of the biface.

The occurrence of the flake culture in India in different context is imperfectly known. It appears, however that as yet no other flake tradition as distinct from the Soan has been recognized and that pure flake industry free of the biface or free of the Soan technique does not occur outside the Punjab. In peninsular India the flake culture as such does not appear to have a distinct or seperate cultural entity.

The basic eco-zonation of India during the Pleistocene is amenable to analysis though the data is of uneven value and quality from one region to another reflecting on the quantity and quality of the available archaeo-stratigraphic information and other lines of inferences. Nonetheless even partial reconstructions do provide working hypothesis of considerable heuristic value.

From the wider geographical point of view India during the Pleistocene period seems to have occupied a lands-end position into which successive groups of Stone Age men entered from west and probably had their first area of colonization in the elevated plateau region in the northwest which in turn might have served as a secondary centre of cultural diffusion. The movement of the Stone Age people all over India appears to be rapid because the earliest archaeolithic horizons in every part of the country appears to be of the same age. Another point which can be made from the analysis of the data is the general aspect of simultaneous cultural evolution in different parts of the country on more or less identical lines. The almost continuous cultural sequence from the second glacio-pluvial period onward would seem to suggest a remarkable climatic tolerance on the part of Stone Age men. At no time did a climatic antagonism of sufficient magnitude sufficient to force people to abandon their habitat developed. Even during unfavourable periods a precarious ecological balance appears to have been maintained. Climatic oscillation could by itself have not been the cause of human displacement.

Expansion of geographical and ecological range appears to be indicated by available data. Lower Pleistocene traces of human existance is lacking. But by the Late Pleistocene, with the possible exception of the swampy and heavily wooded Ganga Valley, the entire sub-continent seems to have been occupied. Towards the end of the Upper Pleistocene hominids effectively filled the country. The total number of hominids must certainly have increased during this process of expansion and there are signs that densities were atleast locally much higher by the end of the Pleistocene.

Scientific attention in regard to the Stone Age has hitherto been focussed extensively on artifacts, although untill recently these were treated as cultural-historic works, rather than as functional parts of operative systems. Various workers have shown that patterns preserved in artifact assemblages may be analysed in various subtle ways so as to provide evidence for the reconstruction of aspects of economy or social organization. The rate of change in material culture system can be visualized by the relative duration of the gross culture stratigraphic divisions. In order to obtain a more analytic perception it is necessary to start compiling a variety of quantitative data concerning artifact assemblages that seem likely to have relavance in assessing the evolution of craft capabilities and technological systems rather than to the specifics of culture-history.

There is some evidence to suggest a rise in the gross abundance and maximum densities of artifacts on archaeological sites through time. Among the factors involved may be the following: increasing sedentary habit, an increase in the importance of tools in the hominid behaviour and a tendency for stone tool knapping to become a habitual hominid pastime, or all of these.

Increase in the maximum level of finesse and refinement in artifacts were achieved at different time periods. These somewhat subjective terms can sometimes be measured and trends firmly defined as, for instance, in the development of refinement shown by handaxe forms through the longtime span of the Acheulian.

Co-ordination of mind, hand and eye is involved in execution of a design on irregular raw-material. The specificity and complexity of the design and the degree of precision with which it is imposed in manufacture are potential indices of levels in the technical capabilities of the evolving brain, as well as the degree of elaboration of cultural system.

Closely associated with the geographic fragmentation of material culture system is the phenomenon of increasing change in the specifics of artifacts. Very often the change appears to be in large measure of a stylistic nature rather than being in themselves progressive. However it may be that the acceleration in the rate of change, the local differentiation and the degree of artifact standardization can be considered together as symptomatic of a great increase in the complexity of cultures, and since the complexity of culture is liable to have been limited in large measure by the efficacy of the communication system, these changes may imply that during the

Upper Pleistocene, language crossed a critical threshold in its information capacity and precission of expression. Concomitant socio-political change may also have been involved.

Despite the many deficiencies of archaeological and chronometric data presented, there seems to be convergence of implications with regard to the tempo of socio-cultural change during the Pleistocene: namely that the rate of development in systemic aspects of culture was initially very low, and only became rapid during the last 5 per cent or less of the 0.5 million or so of the archaeological record. During vast spans of the Lower and Middle Pleistocene time very little measurable change occured. By contrast, during the comparatively brief time span of Late Pleistocene change and differentiation became increasingly rapid and involved important accumulation of innovation and apparently profound modification of the system itself. The available data do not enable us to decide whether the development and complexity of ecological adaptation during the Pleistocene followed smooth geometric growth trend or war episodic. Certainly technology appears to have been subject to episodic change involving threshold as well as to some more steady trend.

A fuller understanding of Pleistocene ecological adaptation and development calls for more intensive archaeological, geophysical and chronometric research with fresh emphasis on systemic feature.

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